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SOLAR ACTIVITY: A BIBLIOGRAPHY

by

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ABSTRACT

This bibliography contains 512 citations to articles on solar activity as evidenced by sunspots, flares, and cosmic and terrestrial effects. In addition, there are listed books dealing with solar activity, and observatory publications and other periodicals reporting routinely observational data and forecasts of periodic events.

FOREWORD

This bibliography was compiled in response to a request by Marshall Space Flight Center for information about current knowledge of the solar cycle, taking into consideration particularly the statistical aspect of solar events and the interaction with the ionosphere.

The overwhelming majority of the cited articles was found in the Astronomischer Jahresbericht, in Science Abstracts (Physics), and in the Bulletin Signalétique, Section 2 (prior to 1961 designated as Partie 1). Others were obtained either from references or from the indexes of periodicals. Many more reports on solar activity research may be found in the proceedings of symposia and in monographs. The most important of these are

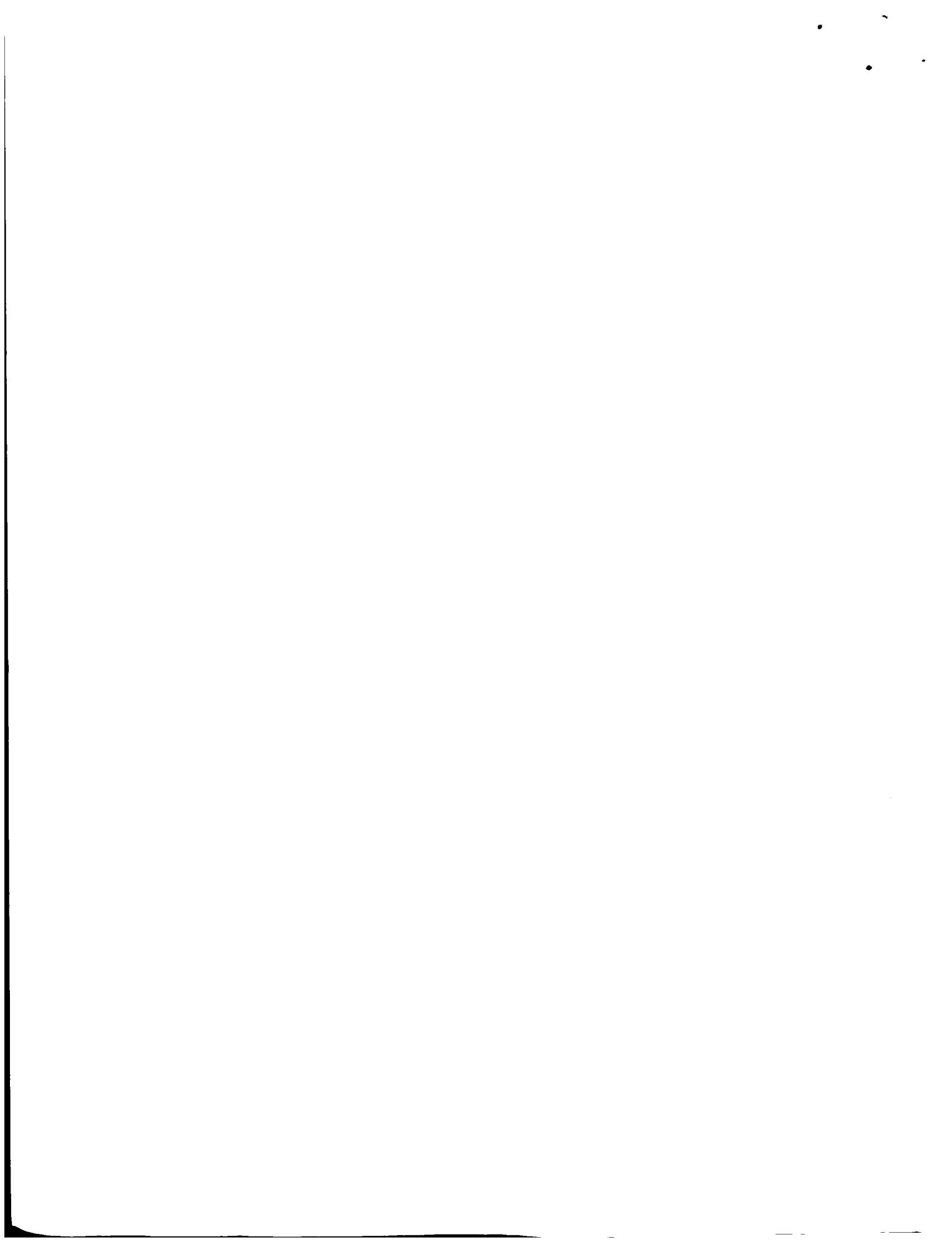> Space Research, Proceedings of the International Space Science Symposia,

> Symposia sponsored by the International Astronomical Union,

> Advances in Space Research, Proceedings of the Inter-American Symposia, and

> COSPAR Information Bulletin.

Observational data as well as sunspot relative number predictions are published routinely in the bulletins, etc., of most observatories. It did not appear practical to attempt a listing of the many articles of this kind that appear in print every year. For this reason only a few reports dealing with unusual events and their interpretations were included.

No claim is made that this bibliography approaches completeness; material antedating 1960 was included only if of a fundamental nature, and some material published after 1964 may not have come to the compiler's attention mainly because later issues of the Astronomischer Jahresbericht are not yet available.

CONTENTS

INTRODUCTION

The tendency to question beyond "Is it edible?" and "Does it endanger me?" is one of the characteristics of the human mind, and so it is not surprising that astronomy appears to have had its inception already at a time when the more outstanding celestial objects were still believed to be legendary figures or, as in the case of the sun, the vehicle of a deity.

Changes in the path of this vehicle and its occasional diminution or even complete disappearance during daytime were probably noted in prehistoric times; inquiries about its size and distance began more than 2000 years ago (Eratosthenes, Hipparchus), but while sunspots were occasionally recorded by Chinese astronomers, their systematic observation in the Western world did not begin until Scheiner became aware of them and Galilei and Fabricius corroborated his discovery.

They and their successors noted numbers, sizes, and distribution of sunspots, and the existence of a cycle of about 11 years' duration was established. But not until Wolf (1849) introduced the "Sunspot Number" was there a practical attempt at statistical study of the phenomenon. The collated data gathered at numerous observatories since then show that in addition to the 11-year cycle (which is part of a 22-year cycle of primarily magnetic activity) there are others, for instance Gleissberg's 80-year cycle and the 178- (=8 × 22-), 400-, and 600-year cycles (Link, Andrenko). Hypotheses about the existence of the long cycles are based on mathematical analysis of the variation of the sunspot numbers and on statistical evaluation of observations of comets. While the 11- and 22-year cycles seem to be well proven by the large number recorded, controversies continue about the others, since the sample is either small (we are still in the third 80-year cycle since the beginning of reliable data collections) or vulnerable because of uncertainties in the supporting evidence such as tree rings, topographic markings, and the relation between sunspots and weather. Thus it may be that the proponents of a correlation between solar activity and comets have the only reliable, long-term clue, since comets have been observed and recorded for about 3000 years, and are not subjected to the vagaries of the weather. Of course, the relation between comets and solar activity can be proven only over as long a time interval as that for which reliable observations of the sun are available, but if a significant correlation is found, it will be invaluable confirmation or refutation of the purely statistical methods. While a definite relation between solar activity and seismic events seems to exist, records of the latter are inadequate as a basis for exploration of the past, and of doubtful value for prediction of the future, because of the influence of as yet unpredictable shifts in air masses.

Unavoidably, the early observations of sunspots were restricted to noting of their nascence and disappearance, their numbers and areas. Next, spectroscope and spectrograph showed them to be substantially the same as the rest of the photosphere, and then discovery of the Zeeman effect resulted in establishing the solar magnetic field and its changes, frequently accompanied by terrestrial effects such as aurorae and geomagnetic storms. Ionizing radiation that had first been assumed to be of terrestrial origin was found to come from cosmic sources, and radio telescopes revealed the secrets of static. These and other discoveries and the studies based on them keep on adding to our knowledge of the sun and its influence on the planet we live on and on space which we have begun to explore.

Section I. PERIODICITY, PREDICTION, AND STATISTICS

1. Afanas'yev, A. N.,
   ABOUT A REGULARITY OF THE DOUBLE CYCLE OF SOLAR
   ACTIVITY, Solar Data, No. 4, 1960, pp. 75-77 (In Russian).

   Not abstracted.

2. Allen, C. W.,
   A SUNSPOT CYCLE MODEL, The Observatory, Vol. 80, 1960,
   pp. 94-98.

   A concept of the sun is developed, based on the polar drift of the
   photosphere layers. The spot phenomenon is accounted for by a
   circulation of magnetic toroids, similar to Bjerknes' theory. It is
   found possible to explain the reversal of the polar fields, the law of
   polarity, the equatorial drift of the spots, the rotation of the positions
   of bipolar spot groups, the acceleration near the equator, the
   coincidence of activity phases on both hemispheres, and the intensity
   of spot-cycles.

3. Alter, G.,
   SUNSPOTS, STATISTICS AND PLANETS, Bulletin of the
   Astronomical Institutes of Czechoslovakia, Vol. 5, 1954, pp. 69-78.

   The contention by F. Link and his co-workers that the planet
   Venus has a provable influence on the relative sunspot numbers
   is refuted by a thorough statistical analysis. Other errors in the
   work of Link's group are pointed out.

4. Altschuler, M. D. and Sastry, C. V.,
   AUTOCORRELATION OF SOLAR ACTIVITY, Nature, London,
   Vol. 206, 1965, pp. 1035-1036.

   A period of 93 days is observed in the autocorrelation of solar
   activity for the 1957 to 1958 period while that for the 1947 to 1948
   period is the more usual 27 days.

5. Anderson, A. D.,
   LONG TERM (SOLAR CYCLE) VARIATION OF THE EXTREME
   ULTRAVIOLET RADIATION AND 10.7-CM FLUX FROM THE SUN,
   Journal of Geophysical Research, Vol. 70, 1965, pp. 3231-3234.

This article demonstrates that the 10.7-cm flux from the sun, generally accepted as a good index of the solar extreme ultraviolet radiation (EUV) does not vary the same as the EUV, especially over a solar-cycle.

6.   Anderson, C. N.,
NOTES ON THE SUNSPOT CYCLE, Journal of Geophysical Research, Vol. 59, 1954, pp. 455-461.

The long sunspot cycle of 169 years was examined, and its periods were analyzed. Period lengths, relative amplitudes, and epochs are given for the 39 harmonics of the 169-year fundamental. In addition it is shown that the influence of the planets on the spot cycles is negligible.

7.   Antalová, A. and Gnevyshev, M. N.,
PRINCIPAL CHARACTERISTICS OF THE 11-YEAR SOLAR ACTIVITY CYCLE, Astronomicheskii Zhurnal, S.S.S.R., Vol. 42, 1965, pp. 253-258; Soviet Astronomy-AJ, Vol. 9, 1965, pp. 198-201.

On the basis of sunspot data published in the Greenwich and Pulkovo catalogs of solar activity during 1874 to 1962, it is shown that the 11-year cycle consists of two maxima which have different characteristics. The relationship of the values of these maxima and the time interval between them determines the form, duration, and, to a considerable degree, the amplitude of the cycle. These results are in full agreement with the conclusions drawn earlier by M. N. Gnevyshev concerning the distribution of coronal intensity for the sun and the variations of this distribution. This makes it possible to conclude that the described behavior is representative of activity in all layers of the solar atmosphere.

8.   Arbey, L.,
REMARKS ON THE WOLF NUMBERS CORRESPONDING TO THE SUNSPOTS BETWEEN 1791 AND 1811, Bulletin Astronomique, Vol. 20, 1956, pp. 347-362 (In French).

Wolf's sunspot relative numbers for the years 1791 to 1811 show fluctuations that cannot be considered valid. They cannot be accounted for by natural events or processes, such as geomagnetism or frequency of the aurora borealis. Nothing contradicts an additional hypothetical fluctuation, nor does anything postulate the existence of one.

9. Babcock, H. W.,
    THE TOPOLOGY OF THE SUN'S MAGNETIC FIELD AND THE
    22-YEAR CYCLE, Astrophysical Journal, Vol. 133, 1961,
    pp. 572-587.

Shallow, submerged lines of force of an initial axisymmetric
dipolar field of 8×10^{21} maxwells are drawn out in longitude by the
differential rotation (after the suggestion of Cowling) to produce a
spiral wrapping of five turns in the north and south hemispheres after
3 years. The amplification factor approaches 45 with a marked
dependence on latitude.

Twisting of the irregular flux strands by the surface shallow
layers in low latitudes forms "ropes" with local concentrations that
are brought to the surface by magnetic buoyancy to produce bipolar
magnetic regions (BMRs) with associated sunspots and related
activity. The field intensity required for producing BMRs is reached
at progressively lower latitudes according to the derived formula
$\sin \phi = \pm 1.5/(n + 3)$, where n is the number of years since the
beginning of the sunspot cycle. This accounts satisfactorily for
Spörer's law and the Maunder butterfly diagram. Sufficient flux
"rope" for more than 10^3 BMRs is produced. "Preceding" parts of
BMRs expand toward the equator as they age, to be neutralized by
merging; "following" parts expand or migrate poleward, so that
their lines of force neutralize and then replace the initial dipolar
field. This process, which involves severing and reconnection of
lines of force in the corona, as well as expulsion of flux loops, need
be only 1 percent efficient. The result, after sunspot maximum,
is a main dipolar field of reversed polarity. The process repeats
itself, so that the initial conditions are reproduced after a complete
22-year magnetic cycle.

This model accounts for Hale's laws of sunspot polarity and
provides a qualitative explanation of the preponderance of "preceding"
spots, of the forward tilt of the axes of older spots, of the recurrence
of activity in preferred longitudes, and of Hale's chromospheric
"whirls."

10. Babcock, H. W.,
     THE SUN'S MAGNETIC CYCLE, Science, Vol. 134, 1961, p. 1425.

Observations with the magnetograph during eight years have shown
that the sun has a poloidal field that reverses its polarity near the
end of the sunspot cycle, and that local magnetic areas, responsible

for sunspots and other forms of solar activity, disappear by expanding. A new theory of the solar cycle is established, based on these findings.

11.   Balli, E.,
A STUDY OF SHORT-PERIOD FLUCTUATIONS IN THE FREQUENCY OF SUNSPOTS, Annales d'Astrophysique, Vol. 18, 1955, pp. 118-126 (In French).

Using the independent statistical criteria of Gauss, Kermack and McKendrick, and Gleissberg, it is shown that the short-period fluctuations undergo a systematic variation whose period is seven to eight 11-year cycles, that is the Gleissberg 80-year cycle.

12.   Baur, F.,
A DETERMINATION IN ADVANCE OF THE POSITION OF THE NEXT SUNSPOT MINIMUM, Zeitschrift für Astrophysik, Vol. 52, 1961, pp. 37-41 (In German).

Calculations based on the relationship between the asymmetric intervals of the ranges, $\frac{1}{2}R_M \to R_M$, $R_M \to \frac{1}{2}R_M$, and the absolute value of the sunspot maximum, R_M, in eighteen 11-year cycles between 1755 and 1954, yield a prediction that the next minimum, R_m, will fall between June 1964 and December 1965, probably in February 1965.

13.   Baur, F.,
NEW CALCULATION OF THE DATE OF THE NEXT SUNSPOT MINIMUM, Zeitschrift für Astrophysik, Vol. 55, 1962, pp. 185-186 (In German).

The decrease of sunspot relative numbers by 95 units from September 1960 to November 1961 makes necessary a recomputation of the probable date of the approaching sunspot minimum. It can now be estimated more accurately than was possible a year ago. It is found that the minimum will probably occur in 1964 or as early as during the last third of 1963.

14.   Behr, A. and Siedentopf, H.,
ON THE STATISTICS OF SOLAR ERUPTIONS, Zeitschrift für Astrophysik, Vol. 30, 1952, pp. 177-184 (In German).

Using data published in the Quarterly Bulletin from 1935 to 1950, the authors determined the number of eruptions per rotation, their correlation with the relative numbers, their distribution on the solar disk, and the visibility effect as function of the distance from the central meridian. The temporal variation of the North-South ratio of eruptions was investigated. Further it was found that in this (then current) cycle the ratio between number of eruptions and relative numbers was by about 25 percent lower than during the preceding cycle.

15. Bell, B. and Glazer, H.,
SOME SUNSPOT AND FLARE STATISTICS, Smithsonian Contributions to Astrophysics, Vol. 3, 1959, pp. 25-38.

This article presents a statistical study of 5940 sunspot groups observed at Mount Wilson between 1937 and 1953, and of 8403 eruptions of these groups. The spot-group distribution among the magnetic classes was made according to size and age. The strongest magnetic fields were generally found in such groups where the largest spot was leading. The known relation of maximum field strength and group area was confirmed, as well as that for the magnetic development. A new investigation of the asymmetry of the spot numbers, weighted according to the magnetic classes and the duration of the visibility, supports Schuster's explanation of the asymmetry as a selective phenomenon. In agreement with Giovanelli, Severny, Hoyle, and Gold, the greatest number of eruptions was found in the complex group of class γ. A relation exists between flare frequency and group area.

16. Besrukova, A. Y.,
ODD-NUMBERED CYCLES AND LONG-TERM PREDICTION OF SPOT RELATIVE NUMBERS, Solar Data, No. 2, 1957, pp. 118-121 (In Russian).

The author has shown previously (Izvestiya Astr. Glavn. Obs., No. 159) that the spot area during the minimum year of the odd-numbered, one-peak cycle is almost twice as large as the area of the preceding two-peak cycle during the year of its first minimum. The present paper brings an analogous study of the spot relative numbers. It is found that there are several methods for calculating in advance the maximum spot relative number for the 19th cycle: from successive cycles, from the 88-year cycle, and from the 44-year cycle.

17.   Besrukova, A. Y.,
       THE DEVELOPMENT OF CYCLE NUMBER 19, Solar Data, No. 5,
       1957, pp. 120-122 (In Russian).

       Not abstracted.

18.   Besrukova, A. Y.,
       THE CHARACTER OF THE NINETEENTH CYCLE OF SOLAR
       ACTIVITY, Izvestiya Astr. Glavn. Obs., Pulkovo, Vol. 20, No. 6,
       1958, pp. 77-102 (In Russian).

       Based on an investigation of the spot areas, the following is to
       be expected: the maximum will occur in the northern hemisphere
       of the sun in 1957; in the southern hemisphere, there will be one
       maximum each in 1956 and in 1958 to 1959.

19.   Besrukova, A. Y.,
       THE SUNSPOT AREA 1957, Solar Data, No. 3, 1958, pp. 78-79
       (In Russian).

       Not abstracted.

20.   Besrukova, A. Y.,
       THE PREDICTIONS OF WOLF SPOT RELATIVE NUMBERS IN
       ODD- AND EVEN-NUMBERED 11-YEAR CYCLES OF SOLAR
       ACTIVITY, Solar Data, No. 11, 1959, pp. 72-74 (In Russian).

       Not abstracted.

21.   Besrukova, A. Y.,
       THE ELEVEN-YEAR CYCLE OF SOLAR ACTIVITY AND THE
       CHARACTER OF THE FLUCTUATIONS OF THE TERRESTRIAL
       ZONE CIRCULATION DURING THE WINTER, Solar Data, No. 7,
       1960, pp. 78-82 (In Russian).

       Not abstracted.

22.   Besrukova, A. Y.,
       THE PROBABLE CHARACTER OF THE CHANGE OF THE ANNUAL
       AVERAGE OF THE WOLF SUNSPOT RELATIVE NUMBERS IN THE
       ELEVEN-YEAR CYCLE NO. 20, Solar Data, No. 5, 1962,
       pp. 76-79, and for Cycle 21, No. 7, pp. 75-78 (In Russian).

       Not abstracted.

23. Besrukova, A. Y.,
        THE EPOCHS OF THE MAXIMA OF THE ELEVEN-YEAR CYCLES
        20, 21, AND 22, Solar Data, No. 8, 1962, pp. 69-74 (In Russian).

        Not abstracted.

24. Besrukova, A. Y.,
        THE LONGITUDINAL DISTRIBUTION OF SPOT GROUP AREAS IN
        THE NORTHERN AND SOUTHERN SOLAR HEMISPHERES,
        Izvestiya Astr. Glavn. Obs., Pulkovo, Vol. 23, 1963, pp. 57-65
        (In Russian).

        Data of the Greenwich photoheliographic catalogs for the years
        1878-1953 were examined for the longitude distribution of the mean
        area sums of spot groups. The smoothed 10-year area sums show
        a trend toward asynchronous development of the spot formation index
        in several neighboring, antipodal longitudes. The spot-forming
        activity was prevalent in the interval between longitudes 121 and
        130 degrees and adjoining areas of the northern hemisphere during
        the 15th, 16th, and 17th cycle. It was found that the longitude
        intervals with the maximum values of the annual sums of the mean
        areas of the spot groups move in a direction opposite to that of the
        rotation of the sun.

25. Besrukova, A. Y.,
        THE DEVELOPMENT OF SPOT FORMATION FROM 1962 TO 1963
        AND THE FLUCTUATION OF SPOT AREAS DURING THE MINIMA
        OF THE 11-YEAR CYCLES, Solar Data, 1964, No. 7, pp. 75-80
        (In Russian).

        The annual averages of the diurnal total spot areas fluctuate as
        well for the entire solar disk as for its Northern and Southern
        hemispheres separately. These fluctuations are correlated with the
        11-year sunspot cycle 1954 to 1963, but they differ for the two
        hemispheres. This asymmetrical behavior is explained by comparison
        with the spot areas during the minima of the preceding eight cycles.

26. Boersma, N.,
        THE DEVELOPMENT OF SUNSPOT GROUPS AND OF LEADER SPOTS,
        The Observatory, Vol. 77, 1957, pp. 239-241.

        It is pointed out that the secular development of the total area of
        large spot groups differs from the development of the area of the

main spots which is most frequently employed in statistical studies. The total area shows an initially noticeably steeper decline, especially after the maximum.

27. Bonoff, A. D.,
     THE 176-YEAR VARIATION OF SOLAR ACTIVITY, Solar Data,
     No. 3, 1957, pp. 110-111 (In Russian).

     A period of 176 = 8 × 22 = 2 × 88 years can be distinctly recognized from the spot observations between 1610 and the present. Over and above this, it appears that this period is only a part of a meta-secular period.

28. Bonoff, A. D.,
     THE 22-YEAR CYCLE OF SOLAR ACTIVITY, Astronomical-Geodetic Society Bulletin, S.S.S.R., No. 21, 1958, pp. 33-36 (In Russian).

     Not abstracted.

29. Bonoff, A. D.,
     THE SECULAR CHANGE OF SOLAR ACTIVITY, Solar Data, No. 3, 1964, pp. 67-70 (In Russian).

     Not abstracted.

30. Bray, J. R.,
     PREDICTION OF THE INTENSITY OF THE PRESENT SUNSPOT CYCLE, Nature, London, Vol. 210, 1965, p. 929.

     Statistical considerations indicate that the activity during the cycle beginning in 1964 might be moderately strong to strong.

31. Brunner-Hagger, W.,
     COMMENTS ON SUNSPOT THEORIES, Orion, Schaffhausen, Vol. 5, 1958, pp. 406-407 (In German).

     The concept is developed that the positions of the planets control the solar activity at large; this applies to both cycles, that of 11 and that of 80 years. As visual demonstration, the path of the mass center of the solar system is shown in reference to the center of the sun for the years from 1900-1960.

32. Bumba, V.,
SLOW CHANGE IN THE MAXIMUM INTENSITY OF THE MAGNETIC FIELD OF REGULAR SPOTS, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 14, 1963, pp. 134-136.

A study of 40 sunspot groups between July and September 1957 shows that the intensity of the magnetic field of the principal spots decreases with the spot area at an average rate of 12 gauss/day.

33. Chadwick, W. B.,
A QUICK METHOD FOR ESTIMATING THE STAGE OF THE SUNSPOT CYCLE, NBS, Journal of Research, Vol. 65D, 1961, pp. 637-640.

A method, based on the maximum median hourly value of f_0F_2 month-by-month as observed at Washington, D. C., is given for predicting a smoothed annual sunspot number immediately at the close of a given month, centered on the month in question. Regression equations and standard errors are given. It should be a useful supplement to the McNish-Lincoln method of prediction of sunspot numbers, particularly during the first 2 years of the rising part of a sunspot cycle. The method is capable of use with the observations from any ionosphere sounding station operated in a consistent manner over a period of years, preferably during at least two solar cycles.

34. Chadwick, W. B.,
EFFECTIVE SUNSPOT NUMBERS, JANUARY 1961 THROUGH JULY 1962, NBS, Journal of Research, Vol. 67D, 1963, pp. 37-38.

In this article, it is proposed that the estimated, smoothed annual sunspot number obtained by the method of a previous paper (Chadwick, item 33) be termed "effective" sunspot number. The series of such numbers is continued through July 1962.

35. Chappell, D. W. G.,
A RELATIONSHIP BETWEEN THE LIFE OF M-REGIONS AND THE RATE OF CHANGE OF SOLAR ACTIVITY, Journal of Atmospheric and Terrestrial Physics, Vol. 17, 1960, pp. 315-319.

To test the hypothesis that the observed lack of success in forecasting disturbance to radio propagation by using the recurrence pattern during the 1953 to 1954 sunspot minimum period is due to the

high rate of decay of the 1947 to 1954 cycle of solar activity,
magnetic character figures for the period 1890 to 1950 were examined.

A numerical definition of "persistence of recurrence" was given,
and a linear relationship is obtained between the maximum value of
this quantity at sunspot minimum and the rate of decay of solar
activity to that minimum. The extremely low value of this quantity
predicted by this relationship for the 1954 sunspot minimum period
is considered to provide confirmatory evidence for the initial
hypothesis.

36.   Chen, Piao,
        ON POSSIBLE REGULARITIES IN SOLAR ACTIVITY, Acta
        Astronomica Sinica, Vol. 10, 1962, pp. 1-7 (In Chinese).

In an analysis of the sunspot activity since 1610, especial
consideration is given to the magnetic cycle of 22-year duration.
The author establishes similarities among groups of three or four
successive magnetic cycles. This regularity ended in 1823.3, but it
appears that in 1933.8, a new, intensified cycle of successive
similarities began; the course of this cycle is predicted until the
year 2020. This prediction agrees with that by C. M. Minnis
(see item 168) but contradicts that by W. Gleissberg (see item 78).*

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*It appears that the discontinuity between groups of cycles
extended over a full number of cycles, but thus far there is no clue
if the number of "different" cycles (five) is significant.

37.   Chen, Piao and Yin, Chun-Lin
        ON THE PERIODICITIES OF SOLAR ACTIVITY, Acta Astronomica
        Sinica, Vol. 13, 1965, pp. 89-96 (In Chinese).

The method of periodograms was applied to the monthly Wolf-
Wolfer numbers from 1749 to 1960 inclusive. Anderson's conjectural
period of 18 years might exist; the period corresponding to
Anderson's lasts 17.75 years. The authors found still another
period of 22.4 years. The frequently mentioned 80-year period
might be deduced from these two.

38.   Chernosky, E. J. and Hagan, M. P.,
        THE ZURICH SUNSPOT NUMBER AND ITS VARIATIONS FOR
        1700 - 1957, Journal of Geophysical Research, Vol. 63, 1958,
        pp. 775-788.

A compilation of the monthly and annual daily relative sunspot number is given for the years 1749 to 1957. Wolf's annual values are recompiled and given, back to 1700, from 1749. Tabular data include monthly, annual, and moving 11-year means and totals. Times of cycle minima and maxima and appearances of first and last spots are indicated. Graphical presentations are given for the annual, 11- and 22-year means, cycle means and cycle totals, and for some monthly and 5-monthly means. A check for continuation of a relationship of secular change to cycle length is made.

39. Chertoprud, V. E.,
THE DISINTEGRATION OF THE SOLAR CELLULAR BELT,
Astronomicheskii Zhurnal, S.S.S.R., Vol. 43, 1966, pp. 390-399;
Soviet Astronomy - AJ, Vol. 10, 1966, pp. 308-314.

An explanation offered previously (item 97) for cyclic solar activity, in which a cellular belt is produced in the convective layer and then decays gradually, is here elaborated by a detailed analysis of how the belt decomposes into cells. Estimates based on very general assumptions confirm the mode of disintegration suggested in item 97. The phase of successively disintegrating cellular belts might be synchronous with the periodically varying fluctuation level.

40. Chistyakov, V. F.,
SOME PECULIARITIES OF THE SOLAR CYCLE NEAR THE MINIMUM, Astronomicheskii Tsirkulyar, S.S.S.R., No. 158, 1955, pp. 22-24 (In Russian).

Contrary to predictions the spot minimum at the beginning of 1954 was about as low as those in 1902 and 1913. The author calculated for this reason the mean relative spot numbers for the 12 months preceding and for the 12 months following each minimum. He found that the temporal course of these curves is very similar to that of the mean spot relative numbers during the years of maxima.

41. Chistyakov, V. F.,
SEPARATION OF THE STATISTICAL REGULARITIES OF THE SUN CYCLICITY IN TWO SERIES, Astronomical-Geodetic Society, Bulletin, S.S.S.R., No. 25, 1959, pp. 12-18 (In Russian).

Not abstracted.

42.   Chistyakov, V. F.,
        THE ALTERNATION RELATION OF SUCCESSIVE 22-YEAR
        CYCLES OF SOLAR ACTIVITY, Solar Data, No. 2, 1959,
        pp. 64-68 (In Russian).

        It is possible to show that, similarly to the successive 11-year
        cycles, the doublecycles too, have a tendency toward alternation
        of strong and weak activity. However, the regularity of the
        alternation is affected by secular periods, particularly in the
        neighborhood of secular maxima and minima.

43.   Chistyakov, V. F.,
        THE NUMBER OF ORIGINATING AND DISAPPEARING SPOT GROUPS
        ON THE ROTATING SUN, Astronomical-Geodetic Society, Bulletin,
        S.S.S.R., No. 28, 1960, pp. 21-26 (In Russian).

        Not abstracted.

44.   Chistyakov, V. F.,
        THE CIRCULATORY NATURE OF THE ELEVEN-YEAR CYCLE OF
        SOLAR ACTIVITY, Astronomicheskii Zhurnal, S.S.S.R., Vol. 37,
        1960, pp. 425-435; Soviet Astronomy-AJ, Vol. 4, pp. 405-414.

        An attempt is made in this article to account for some of the
        features observed in the development of 11-year cycles on the basis
        of Spörer's law, which is invoked as evidence of meridional
        circulation in the surface layer of the sun. Emphasis is laid on the
        fact that, despite different intensity levels, all of the cycles have
        many features in common, related to the latitude drift of sunspot
        zones: the invariance of the shape of Spörer curves $\varphi(t)$; the
        possibility of matching the terminations of descending branches of
        the cyclic curves; and constant mean latitude of the zone at the end
        of a cycle, etc. Analysis of the cyclic migration of the N_φ curves of
        annual distribution of the number of sunspots in latitude makes it
        possible to determine the epoch of maximum for the cycle on the
        basis of Spörer's law, rather than on the basis of intensity parameters.
        The established fact of the slowing of meridional circulatory
        velocity at the end of the cycle is called upon to explain the difference
        in the duration of the ascending and descending branches of the
        cyclic curve.

        The totality of the available observational material is consistent
        with the circulatory model of cyclicity advanced by Bjerknes. The

rise of the cyclic curve is explained by the approach of the active zone to the surface, and the decline of the cyclic curve is explained by the recession of the active zone. The epoch of maximum in the cycle is a limiting epoch in this sense, marking off the ascent and descent of the active zone.

45. Chistyakov, V. F.,
FORECAST OF SOLAR CYCLE NO. 20, Solar Data, No. 9, 1962, pp. 60-64 (In Russian).

Not abstracted.

46. Chistyakov, V. F.,
INTERRUPTIONS IN THE DEVELOPMENT OF 11-YEAR CYCLES OF SOLAR ACTIVITY, Izvestiya Astr. Glavn. Obs., Pulkovo, Vol. 24, 1965, pp. 60-72 (In Russian).

Five of these interruptions have been uncovered. The Wolf numbers of these interruptions led to the detection of some peculiarities in their variations during the 22-year and 80- to 90-year cycles. An attempt is made to predict the principal characteristics of the 20th cycle from these peculiarities.

47. Chvojková, E.,
PREDICTION OF THE DESCENDING PART OF A SUNSPOT CYCLE, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 11, 1960, pp. 27-30.

A two-term formula was established by the author for the course of the sunspot relative numbers. The first term defines the general character of the curve, and is essentially a function of the rise time. The second term represents additional, periodic fluctuations that are superimposed on the general trend. The formula makes it possible to predict the descending part of the sunspot curve after the maximum for a protracted time interval, and corrections based on further observations can be applied. The method is demonstrated on the current cycle.

48. Chvojková, E.,
ON THE PERIODICITY OF SOLAR ACTIVITY, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 16, 1965, p. 123.

The author presents comments on a formula established by Xanthakis (see item 256).

49.   Csada, I. K.,
        ON STRUCTURE OF MAGNETIC FIELD OF THE SUN, Acta physica
        et chemica, Szeged, Vol. 4, 1958, pp. 3-4.

        The temporal fluctuations of the streamer pattern are analyzed
        mathematically by making use of Legendre functions to represent the
        vector field potential. The results imply that the streamer pattern -
        and hence the general field distribution - changes in step with the
        23-year solar magnetic cycle.

50.   Das Gupta, M. K. and Basu, D.,
        SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION
        IN RELATION TO THE SOLAR CYCLE, Nature, London, Vol. 203,
        1964, pp. 626-627.

        In a previous paper (1963), the author showed that during the
        International Geophysical Year, the slowly varying component of
        solar radio emission was limited only within the range 470 to 29,000
        Mc/sec with a maximum amplitude at over 4000 Mc/sec. The present
        analysis examines the data over a longer period in order to study
        this component in relation to the solar cycle. It is concluded that
        the preceding results are true for the whole of the solar cycle. The
        component varies in accordance with the solar cycle and is linearly
        related to the sunspot number.

51.   Das Gupta, M. K. and Basu, D.,
        SOLAR-TERRESTRIAL EVENTS IN RELATION TO THE PHASE OF
        THE SOLAR CYCLE, Journal of Atmospheric and Terrestrial
        Physics, Vol. 27, 1965, pp. 1029-1032.

        Criteria for the classification of solar and terrestrial events are
        defined. The correlation of occurrences of divers events during the
        period from 1956 to 1963 is examined. It is found that sunspots and
        Ca plages appear more frequently during the periods of increasing or
        decreasing solar activity than at the time of maximum activity.

52.   Dezsö, L.,
        STATISTICAL INVESTIGATIONS OF SUNSPOTS BY A NEW METHOD,
        Debrecen Heliophys. Obs., Publications, Vol. 1, No. 1, 1964.

        The author attempts a description of the phases of spot develop-
        ment from changes in the umbrae and penumbrae of individual spots

and of spot groups during a complete cycle from 1922 to 1934. He found that individual spots in one and the same group develop in a similar manner, that the formation and decay of spots cannot be interpreted as phenomena of the same development process, and that the appearing of penumbrae is restricted to initial and terminal phases of the spots.

53. Dinulescu, V.,
SOME REMARKS ON THE DATE OF THE ACTUAL SOLAR ACTIVITY MINIMUM, Acad. of Sciences of Czechoslovakia, Astr. Section, Publications, No. 51, pp. 58-61.

Not abstracted.

54. Dinulescu, V.,
SOME ASPECTS OF THE PERIOD OF THE LAST MINIMUM OF SOLAR ACTIVITY, Studii Cerc. Astr. Seismol., Romania, Vol. 10, 1965, pp. 165-169 (In Romanian).

Some aspects are pointed out by comparison of cycles 19 and 20.

55. Diourkovich, P. M.,
THE SOLAR SYSTEM OF MINIMUM AND MAXIMUM EPOCHS OF THE SUNSPOT ACTIVITY DURING THE TIME INTERVAL FROM 1610 TO 1954, Solar Data, No. 6, 1956, pp. 147-159 (In Russian).

From a review of the sunspot minima and maxima between 1617 and 1947, it appears that the long spot cycle has a duration of 168.2 years, corresponding to a mean length of 11.216 years of the short cycle. Further, the author computed the (then) approaching date of the present maximum to be 1957.2, and the date of the next minimum to be 1967.2.

56. Dizer, M.,
ON THE 80-YEAR CYCLE OF SOLAR ACTIVITY, Annales d'Astrophysique, Vol. 19, 1956, pp. 207-208 (In French).

During the past 100 years, the difference of the heliographic latitudes of spot zones on the northern and southern hemisphere varied systematically, and a minimum occurred during the cycle of 1879 to 1889. This is interpreted as a confirmation of the 80-year cycle of the spot activity.

57.   Dodson, H. W. and Hedeman, E. R.,
        SOLAR MINIMUM AND THE INTERNATIONAL YEARS OF THE
        QUIET SUN, Science, Vol. 143, 1964, pp. 237-240.

        The timing of the cooperative geophysical enterprise known as
        IQSY 1964/1965 had to be determined in advance so as to include the
        minimum period of solar activity in the present cycle. This article
        discusses the various statistical criteria on Zürich relative sunspot
        numbers, monthly numbers of spotless days, solar latitude of spots,
        etc. that were used to forecast the time of minimum, and also to
        provide forecasts of likely solar activity as the 2-year period of
        IQSY progressed.

58.   Dodson, H. W., Hedeman, E. R., and Stewart, R. L.,
        SOLAR ACTIVITY DURING THE FIRST SIX MONTHS OF THE
        INTERNATIONAL YEARS OF THE QUIET SUN, Science, Vol. 145,
        1964, pp. 1050-1052.

        A summary of sunspot occurrences and of the 2800 Mc/sec solar
        flux during the period January to June 1964 is presented in this
        article. The actual minimum of the sunspot cycle cannot yet be
        pinpointed, but it appears that the residual activity at minimum is
        unusually high.

59.   Dodson, H. W., Hedeman, E. R., and Stewart, F. L.,
        SOLAR ACTIVITY DURING THE FIRST 14 MONTHS OF THE
        INTERNATIONAL YEARS OF THE QUIET SUN, Science, Vol. 148,
        1965, pp. 1328-1331.

        A resume of solar data obtained from January 1964 to February
        1965, and a comparison of cycles 18-19 and 19-20 are presented.

60.   Eigenson, M. S.,
        THE 5-6 YEAR CYCLE OF SOLAR ACTIVITY, Lvov University,
        Astr. Obs., Tsirkulyar, No. 32, 1955, pp. 1-6 (In Russian).

        Not abstracted.

61.   Eigenson, M. S.,
        THE PROBABLE CHARACTER OF THE DECLINING BRANCH
        OF THE CURRENT SECULAR CYCLE OF SOLAR ACTIVITY,
        Lvov University, Astr. Obs., Tsirkulyar, No. 34, pp. 16-18
        (In Russian).

        It appears that the current secular cycle, exactly like that
        of the 18th century, will comprise seven instead of eight 11-year
        cycles. As a consequence, the maximum of the secular solar
        activity is to be expected during the seventies if not as early as
        during the sixties.

62.   Eigenson, M. S. and Mandrykina, T. L.,
        THE FLUNCTUATION PROPERTIES OF SOLAR ACTIVITY,
        Lvov University, Astr. Obs., Tsirkulyar, No. 37-38, pp. 59-66
        (In Russian).

        Not abstracted.

63.   Eigenson, M. S. and Mandrykina, T. L.,
        THE INTERRELATIONS OF SOME SUMMARY CHARACTERISTICS
        OF THE ELEVEN-YEAR CYCLE, Lvov University, Astr. Obs.,
        Tsirkulyar, No. 37-38, pp. 80-81 (In Russian).

        Not abstracted.

64.   Eigenson, M. S. and Mandrykina, T. L.,
        THE ASCENDING PART OF THE CURRENT SECULAR CYCLE
        OF SOLAR ACTIVITY, Lvov University, Astr. Obs., Tsirkulyar,
        No. 37-38, pp. 82-90 (In Russian).

        Not abstracted.

65.   Eigenson, M. S. and Mandrykina, T. L.,
        THE ASYMMETRY COEFFICIENT OF THE ELEVEN-YEAR
        CYCLE, AND ITS SECULAR CYCLICITY, Lvov University,
        Astr. Obs., Tsirkulyar, No. 37-38, pp. 91-95 (In Russian).

        Not abstracted.

66.   Eigenson, M. S. and Mandrykina, T. L.,
        A NEW TYPE OF SOLAR AND HELIOPHYSICAL FORECASTS,
        Lvov University, Vestnik (Fizika), 1962, No. 1, pp. 88-89
        (In Ukrainian); Reviewed in Referativnii Zhurnal, S.S.S.R., 1963,
        5.51.459 (In Russian).

67. Ellison, M. A.,
RECENT SOLAR ACTIVITY, Nature, London, Vol. 180, 1957,
p. 1173.

Exceptionally high relative sunspot numbers were found during
the first 10 months of 1957; three of them were > 200, and it is
pointed out that relative numbers of this magnitude occurred
previously only four times since 1749. Other, unusual features are
listed and compared with corresponding earlier solar activities.

68. Feldmann, N.,
STATISTICAL DATA ON THE RELIABILITY OF SHORT-TERM
SUNSPOT PROGNOSES, Frankfurt am Main Universitaet, Astr.
Institut, Veroeffentlichungen, 1964, No. 6 (In German).

During the interval from January 1959 to June 1962, observed
values were compared with the smoothed monthly averages of the
sunspot relative numbers as predicted by the Swiss Federal
Observatory. Percentage errors were computed, and the reliability
of the prognoses in successive time intervals was examined. The
extent to which the reliability of the prognosis depends on the
interval between its formulation and the relevant month was
established.

69. Giovanelli, R. G.,
SUNSPOT MINIMA, The Observatory, Vol. 84, 1964, pp. 57-66.

This article is a concise account of some characteristic
features of sunspot growth and decay around the minimum phase of
the 11-year cycle. From statistical data for both old and new cycles
at sunspot minima, it is demonstrated that the frequency of
appearance of new spotgroups is the prime variable during the
11-year cycle, that such fluctuation is random, and that the
distributions of spot lifetimes and areas follow a reproducible
pattern. In consequence, the frequency-of-appearance data appear
to offer a more satisfactory criterion of sunspot activity within the
11-year cycle than do either sunspot numbers or areas.

70. Gleissberg, W.,
PRELIMINARY DETERMINATION OF THE MEAN DURATION OF
THE 80-YEAR SUNSPOT CYCLE, Naturwissenschaften, Vol. 42,
1955, p. 410 (In German).

Since the time interval since Galilei's observations of sunspots is too short to derive a long-period cycle, the author made use of the closely correlated aurora phenomena, listed by Schove (see items 193 and 194).

Altogether, during the last 16 centuries 20 long cycles become apparent. Each covers between 5 and 11 of the well-known short eleven-year cycles; the mean is 7.1 ± 0.3 cycles. Taking the mean length of the short cycles as 11.1 years, the tabulations indicate a variation of the long cycles between 75.5 and 82.1 years, with an average of 78.8 years.

71.   Gleissberg, W.,
THE PERSISTING OF THE 80-YEAR SUNSPOT CYCLE THROUGH 16 CENTURIES, Istanbul University, Observatory, Publications, No. 57 (In German).

From Schove's lists of the years of solar activity maxima and from a list of the annual averages of the sunspot relative numbers for the years 1700 to 1748, the author traced the 80-year sunspot cycle in the epochs of the maxima to the year 300, and in the ordinates of the maxima and minima to the year 1700. Secular adjusted sunspot minima and maxima are tabulated.

72.   Gleissberg, W.,
AVERAGE SUNSPOT CURVES, Astronomische Nachrichten, Vol. 283, 1956, pp. 23-27 (In German).

The eighteen 11-year cycles since 1755 were divided into three groups of six cycles each, depending on the height of the maxima. By suitable averaging of the groups, one curve is obtained for each showing the average development of the adjusted monthly averages of the sunspot relative numbers for cycles with high, moderate, and low maxima. The three average sunspot curves are useful for the examination of mathematical formulations of the sunspot frequency.

73.   Gleissberg, W.,
CONSTANCY OF THE SCALE OF SUNSPOT RELATIVE NUMBERS, Naturwissenschaften, Vol. 43, 1956, p. 196 (In German).

Re-examination of the data for the years from 1878 to 1953 shows that a considerable change of the scale of sunspot relative numbers cannot have occurred during that interval. This, and a

re-determination of the proportionality factor a, established that Waldmeier's value for the ratio area sum/relative number is too high. This ratio is directly proportional to the relative number; a definite change of the relative number scale was not provable by this study.

74.   Gleissberg, W.,
        PREVIEW OF THE SUNSPOT MAXIMUM, Sterne, Vol. 32, 1956, pp. 72-76 (In German).

        This article is a review of the author's method of forecasting solar activity, based on the long, 80-year cycle. Difficulties in prediction, especially for the current cycle, are pointed out.

75.   Gleissberg, W.,
        WILL THE SUNSPOT FREQUENCY CURVE REPEAT ITSELF?, Sterne, Vol. 32, 1956, pp. 188-192 (In German).

        The similar development of the sunspot curves for 1755 to 1790 and for 1923 to 1955 does not make permissible further interpolating, either toward future or toward past values. In proof of this, sunspot curves are shown as derived from northern lights observations since 290 A.D.

76.   Gleissberg, W.,
        THE COURSE OF THE EIGHTY-YEAR SUNSPOT CYCLE, Sterne, Vol. 34, 1958, pp. 117-122 (In German).

        The variations during the 80-year cycle of the spot frequency and its relative fluctuation, of the spot distribution on the northern and southern hemisphere, and of the asymmetry of the positions of the northern and southern spot zones relative to the solar equator are described.

77.   Gleissberg, W.,
        THE EIGHTY-YEAR SUNSPOT CYCLE, British Astronomical Association, Journal, Vol. 68, 1958, pp. 148-152.

        After a presentation of the history preceeding the discovery of the 80-year sunspot cycle, its properties and its indications in Schove's list of the old-time northern-lights maxima are described.

78. Gleissberg, W.,
THE CHARACTER OF THE NEXT SUNSPOT MAXIMUM,
Zeitschrift für Astrophysik, Vol. 49, 1960, pp. 25-29 (In German).

The probability laws of sunspot variations, which have yielded
successful predictions for the last two sunspot cycles, lead to the
conclusion that the next sunspot maximum will very probably be weak.
For, it can be expected with a probability of 0.95 that, during the
next 11-year cycle, the smoothed monthly averages of the relative
sunspot numbers will not exceed 87.7.

79. Gleissberg, W.,
ON SOLAR ACTIVITY BEFORE 1750, Naturwissenschaften,
Vol. 47, 1960, p. 197 (In German).

Chernosky and Hagan recently adjusted Wolf's annual averages
of the sunspot relative numbers for the years 1700 to 1748. Based on
this work, and using the 80-year cycle and Waldmeier's relation
between rise time and maximum height, the author obtained
improved maxima and minima of the solar activity.

80. Gleissberg, W.,
STUDY OF THREE EIGHTY-YEAR CYCLES OF SOLAR ACTIVITY,
Zeitschrift für Astrophysik, Vol. 55, 1962, pp. 153-160 (In German).

The annual averages of the Wolf sunspot relative numbers for
the last twenty-four 11-year activity cycles (with three 80-year
periods) are reviewed and analyzed. The author notes the following
regularities: intensity and asymmetry of the 11-year cycles
increased, the rise time of the sunspot curves decreased, and the
depth of the maxima increased. This seems to indicate the
existence of a third, very long period of solar activity. No temporal
change in the decay time of the sunspot curves and in the time
interval of two 11-year cycles was found.

81. Gleissberg, W.,
PROGRESSIVE CHANGE OF SOLAR ACTIVITY, Sterne, Vol. 39,
1963, pp. 107-110 (In German).

The 32 solar activity cycles since 1610 were divided in four
groups of eight cycles each, and the average duration of increase
and decrease of each group was determined. It was found that the
rise time decreases steadily, corresponding to the increase of the

maxima, but no systematic temporal change of the decay time could be identified.

82. Gleissberg, W.,
     ASCENT AND DESCENT IN THE EIGHTY-YEAR CYCLES OF SOLAR
     ACTIVITY, British Astronomical Association, Journal, Vol. 76, 1966,
     pp. 265-268.

     The author discusses the essential difference between the 11-year
     cycle and that of 80 years, as pointed out by Rubashev.

83. Gnevyshev, M. N.,
     THE 11-YEAR CYCLE IN SOLAR RADIO EMISSION,
     Astronomicheskii Zhurnal, S.S.S.R., Vol. 42, 1965, pp. 488-493;
     Soviet Astronomy-AJ, Vol. 9, 1965, pp. 387-391.

     Variations in solar radio-emission flux levels at wavelengths
     from 3 to 450 cm have been studied over the 1953 to 1963 11-year
     cycle. It is shown that the basic properties of the 11-year solar-
     activity cycle as established by optical observation are fully reflected
     in solar radio-frequency emission. The difference in the shapes of
     the 11-year radio-emission curves for different wavelengths is
     explained by the width of the solid angle of the respective radiations.
     Meter-wavelength radio emission, and the proton component of solar
     radiation emerge from the sun in narrow, solid angles.

84. Gnevyshev, M. N.,
     ON THE ARTICLES PUBLISHED BY YU. I. VITINSKII AND
     G. P. SHCHEGOLEVA IN SOLAR DATA, 1965, pp. 11-12, Solar
     Data, 1966, No. 4, pp. 65-69 (In Russian).

     The author replies to critical remarks about his study of the
     maximum of the 11-year cycle of solar activity.

85. Gnevyshev, M. N. and Krivsky, L.,
     THE RELATION BETWEEN PROTON FLARES AND THE CORONA
     OVER THE 11-YEAR CYCLE, Astronomicheskii Zhurnal, S.S.S.R.,
     Vol. 43, 1966, pp. 385-389; Soviet Astronomy-AJ, Vol. 10, 1966,
     pp. 304-307.

     Over the 11-year solar cycle two maxima occur in the count of
     proton and chromospheric flares, as well as in the areas of sunspots,

number of prominences, and in the intensity of the corona and of solar radio emission. Proton flares develop in regions of enhanced coronal brightness. During the second maximum, strong phenomena, such as cosmic-ray flares, predominate particularly. The proton flares recorded during 1954-1964 are catalogued.

86. Godoli, G. and Allen, C. W.,
    THE INDICES OF SOLAR ACTIVITY, Planetary and Space Science,
    Vol. 12, 1964, pp. 349-354.

    This article is concerned mainly with the quantitative expressions used for describing the various characteristics and nature of the most relevant correlations of solar phenomena which vary systematically with the 11-year cycle. Geophysical indices are not included.

87. Godoli, G.,
    GLEISSBERG'S LAW AND THE BABCOCK-KOPECKY THEORY,
    Atti Accad. Nazion. Lincei, Rendiconti, Cl. Sci. fis., mat., nat.,
    Vol. 37, 1964, pp. 155-159 (In Italian).

    The author made comparisons with observations. The theory predicts for the velocity of the latitudinal migration from the zone of maximum activity of sunspots a value about twice the one observed at the beginning of the cycle, and a value about half of that observed at the end of the cycle.

88. Godoli, G. and Tagliaferri, G. L.,
    MAXIMA OF THE ELEVEN-YEAR CYCLE OF SOLAR PHENOMENA,
    Nature, London, Vol. 207, 1965, pp. 1283-1284.

    An analysis was made of the annual means of the indices of several phenomena of solar activity during cycles 16 to 19. It was found that the intensity of other solar phenomena remains constant, though that of the sunspot maxima increases. It seems even that the intensity of the maxima of faculae and of H_α protuberances and plages has decreased.

89. Godoli, G.,
    ON THE TUOMINEN ASSUMPTIONS ABOUT THE BABCOCK THEORY,
    The Observatory, Vol. 86, 1966, pp. 243-245.

    The author analyzed the expressions for $[H_\phi]_0$ given by Babcock and by Tuominen; he discusses which one is in better agreement with observations as far as the butterfly diagram is concerned.

90.   Gold, L.,
       GRAVITATIONAL-MAGNETIC ORIGIN OF SUNSPOTS AND RELATED
       PHENOMENA, Xth International Astronautical Congress, London,
       1959, Proc. I, pp. 376-382, Wien, Springer Verlag, 1960.

       It is supposed that the anisotropy in the surface flow of the solar
       atmosphere, which is induced by gravitational perturbations of the
       planetary system, causes a corresponding anisotropy of the magnetic
       field. This anisotropy, in turn, may cause temperature and pressure
       variations. Contrary to the old theory of tides which is based on the
       marked correlation between the distribution of the sunspots and the
       configuration of the planets, the new theory, which is based on a
       force of gravitational and magnetic character, gives an explanation
       in the framework of magnetohydrodynamics. The relations between
       the periodicity of the sunspots and that of the coronal structure can
       be understood, as well as the localization of sunspots in the
       equatorial region.

91.   Granger, C. W. J.,
       A STATISTICAL MODEL FOR SUNSPOT ACTIVITY, Astrophysical
       Journal, Vol. 126, 1957, pp. 152-158.

       By an empirical approach, a simple two-parameter statistical
       model is proposed for fitting to the Wolf sunspot number data, and
       a fit of around 88 percent of the total variation is found. Properties
       of the two parameters are discussed, and other possible relationships
       between measurable elements of the cycles are suggested.

92.   Greatrix, G. R.,
       ON THE STATISTICAL RELATIONS BETWEEN FLARE INTENSITY
       AND SUNSPOTS, Royal Astronomical Society, Monthly Notices,
       Vol. 126, 1963, pp. 123-133.

       A statistical analysis of data relating to nearly 4000 solar flares
       for the periods 1 January 1947 to 1 May 1949 and 1 January 1956 to
       1 January 1957 yielded the following principal results:

       a)   The intensity of a solar flare is dependent on the geometry
            of the associated sunspot magnetic field. The more complex
            the geometry, the greater the probability of an intense flare
            occurring. The intensity is independent of the rate of
            change in the area of the spot group.

b)   The frequency of solar flares occurring in a given interval of time and associated with a given spot group is a linear function of the area of the spot group, and of the rate of change in that area.   It is shown that, for the purpose of this work, the area of a spot group can be used as an approximate measure of the magnetic flux passing through that group.

Thus, the relations between solar flares and spot area can be regarded as being the relations between solar flares and magnetic flux.

93.   Grenat, H.,
SOLAR PERIODICITIES, Annales d'Astrophysique, Vol. 23, 1960, pp. 262-277 (In French).

For better statistical evaluation of the periodicity of solar activity, the function $W = 10\sqrt[3]{S}$ is introduced instead of the area S of the spots.   This transformation makes it possible to employ the usual statistical methods, since singularities have been eliminated and the difference curve $\Delta(W)$ has been brought in usable shape.   The method is tested on the Greenwich spot areas from 1874 to 1955.   In addition to the main period, several harmonics were noticeable.

94.   Groubé, W.,
REFLECTIONS ON THE SOLAR CYCLE, L'Astronomie, France, Vol. 79, 1965, pp. 87-88 (In French).

The duration of cycles is considered in view of data on the length of cycle minima and maxima from 1784 to 1964.

95.   Gudzenko, L. I. and Chertoprud, V. E.,
AN ANALYSIS OF PERIODIC SOLAR ACTIVITY, Astronomiche-skii Zhurnal, S.S.S.R., Vol. 39, 1962, pp. 758-760; Soviet Astronomy-AJ, Vol. 6, 1962, pp. 590-591.

A preliminary study has yielded empirical equations for the variations in solar activity.   The equations may be useful for predicting activity and for studying physical processes on the sun.

96.   Gudzenko, L. I., Medvedeva, N. A., and Chertoprud, V. E.,
        ON THE LATITUDE DISTRIBUTION OF THE CYCLIC ACTIVITY
        OF THE SUN, Astronomicheskii Tsirkulyar, S.S.S.R., No. 342,
        1965 (In Russian).

        A statistical analysis of the distribution at phases ϑ is presented.

97.   Gudzenko, L. I. and Chertoprud, V. E.,
        ONE MODEL OF SOLAR CYCLIC ACTIVITY, Astronomicheskii
        Zhurnal, S.S.S.R., Vol. 42, 1965, pp. 267-275, Soviet
        Astronomy-AJ, Vol. 9, 1965, pp. 208-214.

        The model of the spot formation cycle in which the cellular zone
        originates and gradually decays in the convective layer is discussed.
        Separate cells which become detached from the zone and "float up"
        appear in the form of spot groups. The characteristics of the
        simplest model of decay of the cellular zone are in qualitative
        agreement with observational data on solar activity. The physical
        interpretation of the model is discussed.

98.   Gudzenko, L. I. and Chertoprud, V. E.,
        SOME DYNAMIC PROPERTIES OF THE CYCLIC ACTIVITY OF THE
        SUN, Astronomicheskii Zhurnal, S.S.S.R., Vol. 41, 1964,
        pp. 697-706; Soviet Astronomy-AJ, Vol. 8, 1964, pp. 555-562.

        The reduction of recordings of Wolf numbers on the basis
        of the "black box without any window" scheme permits the
        determination of some phenomenological properties of the cyclic
        activity of the sun. Differential equations characterizing the
        process are calculated in the first approximation.

99.   Gudzenko, L. I. and Chertoprud, V. E.,
        ANALYSIS OF A SELF-OSCILLATORY, SYNCHRONOUS,
        UNCONTROLLED OBJECT, Izvestiya Vysshikh Uchebnykh
        Zavedeniy, Radiofizika, Vol. 8, 1965, pp. 1213-1228 (In Russian).

        Beginning with the condition that the signal of a synchronous
        generator is the sole source of information, a study was made of the
        possibility to determine by statistical analysis of the signal the
        properties of the generator, and to evaluate also the periodic action
        of the synchronizing generator, using as basis a statistical analysis
        of the cyclic activity of the sun.

100. Gudzenko, L. I. and Chertoprud, V. E.,
SOME PROPERTIES OF THE PHASE OF SOLAR ACTIVITY,
Astronomicheskii Zhurnal, S.S.S.R., Vol. 43, 1966, pp. 113-123;
Soviet Astronomy-AJ, Vol. 10, 1966, pp. 89-96.

An analysis of the statistical properties of the phase of solar
activity leads to the conclusion that the changes of solar activity are
caused by an autonomous generator with one degree of freedom,
synchronized with a weak periodic force.

101. Guo, C.-s.,
AN EMPIRICAL FORMULA FOR THE SUNSPOT RELATIVE NUMBERS,
Acta Astronomica Sinica, Vol. 11, 1963, pp. 60-62 (In Chinese).

Mathematical analysis of the Zürich annual relative sunspot
numbers R since 1755 leads to a maximum R = 100 for the next
cycle, and to still lower maximal relative numbers for the two
following cycles.

102. Haupt, H., Ellerboeck, W., and Kern, R.,
THE SUNSPOT RELATIVE NUMBERS OBSERVED AT THE SUN
OBSERVATORY KANZELHOEHE AS FUNCTIONS OF SEEING
AND CLASSIFICATION, Akademie der Wissenschaften,
Oesterreichische, Anzeiger, Math.-Naturwiss. Kl., Vol. 96,
pp. 237-245.

For the last 3 years, the sunspot relative numbers R = k (10g + f)
were reduced to the Zürich scale by use of the earlier determined
factor k; even so, there were major deviations from the definitive
Zürich scale. The problem was to find the cause of this discrepancy,
and to determine new factors for everyday use. In particular, it
was necessary to determine if a deterioration of the atmospheric
conditions on the Kanzelhoehe was responsible for this phenomenon,
or if the different observers and the ensuing classification differences
were the causes. Further to be studied were the quality of the
picture as affected by atmospheric conditions, and the classification
of the spot groups by itself.

103. Herrinck, P.,
PREDICTION OF SUNSPOT NUMBERS UNTIL THE END OF THE
PRESENT CYCLE, Nature, London, Vol. 184, 1959, pp. 51-52.

The 169-year sunspot period discussed by Anderson (see item 6), which is based on the very close coincidence of the periods from 1749 to 1785 and from 1918 to 1954, was used in Leopoldville successfully as basis for ionospheric predictions. After establishing numerically the correlation of the dates from April 1954 to October 1958 with those 169 years earlier (today = 1.527 × past - 13.4), monthly predictions are made for the interval January 1959 - December 1967.

104.   Heuseler, H.,
ON THE PERIODICITY OF THE SOLAR ACTIVITY, Deutsche
Vereinigung der Sternfreunde, Nachrichten-Blatt, Vol. 15, 1965,
pp. 102-104 (In German).

Statistics are given of the spots during the cycles from 1749 to 1964.

105.   Howard, R.,
ON THE RELATION OF MAJOR SOLAR FLARES WITH CHANGES
IN SUNSPOT AREAS, Astrophysical Journal, Vol. 138, 1963,
pp. 1312-1313.

An inspection of all the Greenwich sunspot penumbral areas for those solar flares which generated cosmic-ray increases during the years 1942 to 1962 indicates that, in each case, the associated spot-group decreased in area from the day before to the day after the flare. A study of the Mount Wilson magnetic-field data for the flares of 28 February 1942 and 25 July 1946 shows that there was no appreciable change in the measured field strengths from the day before to the day after the events. The effect of a major solar flare seems equivalent to a rapid aging of the spot group, and this is a characteristic which does not apply to all flares.

106.   Huttly, A. N.,
A REVIEW OF RECENT INVESTIGATIONS INTO SUNSPOT CYCLES,
Marconi Review, Vol. 20, 1957, pp. 117-129.

A critical review of some recent (1939 to 1956) papers on sunspot cycles. A selection of papers was made which typified the many different approaches to a means of forecasting sunspot numbers. In addition to the papers under review, a short list of other references is included while still more references can be found from the quoted papers themselves. A short note on the behavior of the present sunspot cycle is also given.

107. International Colloquium,
SOLAR RADIO EMISSION, Akademie der Wissenschaften, Deutsche,
Monatsberichte, Vol. 7, 1965, pp. 111-131.

Resumes are given of the papers presented; several of these
had been published earlier, the others were published subsequently.

108. Jonah, F. C.,
SOLAR ACTIVITY CATALOGUE FOR THE NINETEENTH SOLAR
CYCLE, American Geophysical Union, Transactions, Vol. 45, 1964,
pp. 626-627.

This article is a resume of a paper presented by the author
at the Western National Meeting of the American Geophysical Union,
held at the University of Washington, Seattle, December 28-30,
1964.

109. Jose, P. D.,
SUN'S MOTION AND SUNSPOTS, Astronomical Journal, Vol. 70,
1965, pp. 193-200.

An investigation disclosed that the variation in the motion of the
sun about the center of mass of the solar system has a periodicity of
178.7 years. The sunspot cycle is found to have the same period.

110. Kashirin, G. F. and Rodionov, A. V.,
THE FLUCTUATION INDICES OF SOLAR ACTIVITY, Lvov
University, Astr. Obs., Tsirkulyar, Nos. 37-38, 1962,
pp. 56-58 (In Russian).

Not abstracted.

111. Kashirin, G. F.,
THE FINE-STRUCTURE OF THE LATITUDE DISTRIBUTION OF
THE SUNSPOT GROUPS, Lvov University, Astr. Obs., Tsirkulyar,
Nos. 37-38, 1962, pp. 96-98 (In Russian).

Not abstracted.

112. King-Hele, D. G.,
PREDICTION OF FUTURE SUNSPOT CYCLES, Nature, London,
Vol. 199, 1963, pp. 226-227.

It is shown that from 1788 onward a seven-cycle recurrence tendency in the time of rise from sunspot minimum to maximum persists throughout. Based on this tendency, and on the Zürich minimum R-values in successive cycles, predictions are made for the remainder of the present cycle, and for the two succeeding cycles to commence at 1964.0 and 1974.6, respectively.

113.   King-Hele, D. G.,
PREDICTION OF THE DATES AND INTENSITIES OF THE NEXT TWO SUNSPOT MAXIMA, Nature, London, Vol. 209, 1966, pp. 285-286.

Dates for these maxima were calculated by means of a recurrence method. The prediction is considered of value for estimates of the lifetime of artificial satellites.

114.   Kiral, A.,
METHOD OF AUTOCORRELATION AND CYCLES OF SOLAR ACTIVITY, Istanbul University, Fen Fak. Mec., Seri C, Vol. 26, 1961, pp. 12-22.

This article presents an application of this method to a series of observations recorded by Schove, extending from 290 to 1947. Analysis of the correlogram and of the power spectrum is also included.

115.   Kleczek, J.,
OCCURRENCE OF ERUPTIVE PROMINENCES, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 15, 1964, pp. 41-44.

In the years from 1938 to 1961, 39 eruptive protuberances were observed at the sun's limb. From this catalog and from the catalogs by Buss and by Pettit the distribution of eruptive protuberances according to heliographic latitude, maximum height and speed is graphically shown. From the data it is concluded that it is equally probable for protuberances of the main and of the polar zones to become eruptive. The highest eruptive protuberances were observed at the times of spot maxima in the polar zones, while the fastest protuberances occurred also at the times of sunspot maxima but in the main zone.

116.   Klyakotko, M. A.,
        THE SIGNIFICANCE OF THE CORRELATION COEFFICIENTS OF
        THE VELOCITIES OF LATITUDE DISPLACEMENT OF
        NONRECURRENT SUNSPOTS FOR SEVERAL YEARS, Astron-
        omicheskii Zhurnal, S.S.S.R., Vol. 36, 1959, pp. 550-551; Soviet
        Astronomy-AJ, Vol. 3, 1959, pp. 534-536.

        An estimate is made of the probability that the correlation
        coefficients of the velocities of latitude displacement of nonrecurrent
        sunspots for a number of years arise purely by chance. It is shown
        that this probability is small, i.e., the coefficients are not spurious
        quantities, which confirms the presence of structure in the velocity
        field describing the motion of nonrecurrent sunspots along the
        latitude.

117.   Klyakotko, M. A.,
        SOME PECULIARITIES OF THE MERIDIONAL CIRCULATION ON
        THE SUN, Astronomicheskii Tsirkulyar, S.S.S.R., No. 224, 1961,
        pp. 7-10 (In Russian).

        The possibility is demonstrated of identifying the extremes
        of the velocity fields of the latitudinal motions of non-recurrent
        sunspot groups in the years 1874-1948, 1950, and 1951. The
        character of these extremes confirms the hypothesis by
        R. S. Gnevysheva on the existence of circulation on the sun.

118.   Klyakotko, M. A.,
        THE CHARACTER OF LARGE-SCALE MOTIONS IN THE SOLAR
        PHOTOSPHERE, Astronomicheskii Zhurnal, S.S.S.R., Vol. 39,
        1962, pp. 981-986; Soviet Astronomy-AJ, Vol. 6, 1962, pp. 763-767.

        The character of large-scale motions on the sun is considered.
        It is concluded that in the solar photosphere the motion is predominantly
        circulatory. This coincides with the conclusion obtained earlier * It
        is found that the characteristic dimensions of circulation vary with
        the phase of the cycle of solar activity. The dimensions decrease
        toward minimum solar activity in the northern hemisphere and
        increase in the southern hemisphere.

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        *Astronomicheskii Tsirkulyar, S.S.S.R., 1961, No. 224.

119. Klyakotko, M. A.,
PERIOD OF VARIATION OF CHARACTERISTIC DIMENSIONS OF CIRCULATION ON THE SUN, Astronomicheskii Zhurnal, S.S.S.R., Vol. 40, 1963, pp. 776-778; Soviet Astronomy-AJ, Vol. 7, 1963, pp. 590-591.

Variations in the characteristic dimensions of circulation with the phase of solar activity are confirmed. The characteristic dimensions of the circulation in the Northern and Southern Hemispheres vary in opposite phase, i.e., when the maximum dimensions are in the Northern Hemisphere, they will be minimum in the Southern, and conversely.

The maximum and minimum characteristic dimensions of circulation occur near the solar activity minima.

The period of variation of characteristic dimensions of circulation is apparently 22 years.

120. Kopecký, M.,
THE OUTLINE OF THE THEORY OF DISTRIBUTION AND OCCURRENCE OF SUNSPOTS ON THE SOLAR DISC, Acad. Sci., Czechoslovak, Astronomical Section, Publications, No. 28, 1956.

The general theory of the distribution and appearance of sunspots is based on simplified hypotheses. The following problems are considered: determination of the principal relations and functions, the decline of the spots toward the solar limb, the number of spots appearing and disappearing at different distances from the central meridian, the number of spot groups formed on the entire sun, and their average lifetime. The importance of these characteristics in research on the periodicity of the solar activity is explained.

121. Kopecký, M.,
PREDICTIONS OF SOLAR ACTIVITY, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 7, 1956, pp. 5-7.

This article presents compilation of sunspot cycle predictions arrived at by different methods. It is shown that highly probable predictions are not yet possible, and will have to wait until the real mechanism of solar activity will have been clarified.

122. Kopecký, M.,
PRESENT ERRORS IN DETERMINING SUNSPOT PERIODS,
Postepy Astr., Vol. 6, 1958, pp. 39-44 (In Polish).

Those predictions which are based on empirical laws of the sunspot periodicity are faulty. It is therefore necessary to find a forecasting method including all heretofore known relations. One of the main errors made in the study of the sunspot periodicity is the application of relative numbers that represent only the number of the observed spot groups. Better characteristics than the relative numbers are necessary. One new characteristic is the mean intensity of the sunspot groups (suggested by Eigenson). A new method might consist in study of the spot periodicity on the visible and the invisible solar hemisphere, and of the mean lifetime of the spots.

123. Kopecký, M.,
PROGRESS OF THE NUMBER OF NEW SUNSPOT GROUPS AND THEIR AVERAGE LIFETIME DURING THE EPOCH 1874-1950, Acad. Sci., Czechoslovak, Astr. Section, Publications, No. 42, 1958 (In Czechoslovakian).

From the Greenwich photographic observations of sunspots, the number of new spot groups on the visible and on the invisible sun hemispheres, and their average lifetime during the epoch 1874 to 1950 was calculated for the entire surface of the sun, and for the northern and southern hemispheres, separately. The smoothed averages of 27 rotations of the sun, and the average annual values are given for these two characteristics. Their initial and final values are tabulated, and the progress of the smoothed averages of 27 rotations is shown graphically. It appears that the 11-year period of the relative number is caused by the 11-year period of the number of newly-originated spot groups, although the number of these is practically not affected by the 80-year period. However, the 80-year cycle of the relative numbers is caused by the 80-year cycle of the mean lifetimes of the spot groups: In this case, the mean lifetime is practically not related to the 11-year cycle.

The author examines a number of other properties of the progress of the number of newly-formed groups and their average lifetime, as well as the dependence of these characteristics on the heliographic latitude during the epochs of the maxima and minima.

124. Kopecký, M.,
THE MEASURES OF THE AVERAGE MAGNITUDE OF SUNSPOTS,
Lvov University, Astr. Obs., Tsirkulyar, No. 34, 1958, pp. 1-2
(In Russian).

Distinct positive correlations were found for the periodicity of
groups, the average maximal area of groups, and their average life-
time. These three measures were used in the determination of the
average magnitude of sunspot groups.

125. Kopecký, M.,
ABOUT TWO PERIODS OF SOLAR ACTIVITY, Ríše Hvězd, Vol. 39,
1958, pp. 108-109 (In Czechoslovakian).

The 11-year period of the relative numbers is caused by the
11-year period of the spot groups, and the 80-year period of the
relative numbers is caused by the 80-year period of the mean lifetime
of the groups. The mean lifetime of the spot groups does not affect
the 11-year period, and the number of formed groups does not have
any relation to the 80-year period.

126. Kopecký, M.,
THE CYCLICITY OF PHYSICAL INDICES AND ITS RELATION
TO THE CYCLICITY OF THE SPOT-ORIGINATING ACTIVITY
OF THE SUN, Solar Data, No. 3, 1959, pp. 79-82 (In Russian).

The number of sunspots originating during a time unit and their
mean lifetimes were determined from the Greenwich observations
(1874 to 1950), thus describing the relation between the Wolf spot
relative numbers and the spot-originating activity.

127. Kopecký, M.,
PERIODICITY OF THE NUMBER OF ORIGINATED SUNSPOT
GROUPS AND OF THEIR AVERAGE LIFE TIME, AND EVALUATION
OF THE METHOD OF THEIR COMPUTATION, Astronomical Institutes
of Czechoslovakia, Bulletin, Vol. 11, 1960, pp. 35-52.

In this continuation of earlier research it is shown that the
irregular distribution of the spot-generating areas of the sun and its
discontinuous observation did not affect the calculated average life
time of the sunspots; however, it has the effect of reducing the
calculated number of sunspots below the number of observed sunspots.
It is further shown that the number of originating spot groups is
subjected to an 11-year cycle, and the mean life time of sunspot

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groups follows an 80-year cycle. The observed curve of the sunspot relative numbers is the product of these two factors, and it cannot be represented by their simple addition. The different spot numbers in the two hemispheres are caused by the different numbers of originating groups, but the life time of the spots has no effect on this.

128.   Kopecký, M.,
THE DAILY AVERAGE AREA OF SUNSPOT GROUPS AS CHARACTERISTIC OF THEIR AVERAGE IMPORTANCE, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 11, 1960 pp. 110-113.

It can be shown that the daily, average area of the spot groups, that is, the ratio of the total observed area of spot groups to the total number of groups visible on individual days, is a useful characteristic of the average intensity of the spot groups. Its value depends only on the average lifetime of the spot groups. Its application is useful, especially when determination of the average lifetime must be based on limited statistical material. This characterization of the spots is helpful also in the study of the dependence of the average intensity of spot groups on the heliographic latitude, and on the phase of the 11-year cycle.

129.   Kopecký, M.,
SOME COMMENTS ON BECKER'S SECONDARY ZONE OF SUNSPOTS, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 11, 1960, pp. 158-162.

This study confirms the reality of Becker's secondary spot zone, and it shows that during over-average, active, 11-year cycles this zone extends into high heliographic latitudes. The average spot-group area, which is Becker's characteristic of sunspots, is discussed from the point of view of its usefulness for the study of spot-periodicity.

130.   Kopecký, M.,
SOME REMARKS ON THE METHODS OF RESEARCH INTO THE PERIODICITY OF SUNSPOTS, Annales d'Astrophysique, Vol. 24, 1961, pp. 64-67.

From the physical point of view, the relative numbers and total areas of sunspots are unsuitable for research into the periodicity of sunspots, because they are a conglomerate of various, physically

primary, quantities. The method of superposing periods is unsuitable for research into the periodicity of sunspots, because it is contrary to the physical character of the relative number and total area of sunspots. The application of other statistical methods is only useful if they proceed from a physical analysis of the problem under examination and from the material which is elaborated. Further research into the periodicity of sunspots will be justified only if physically-substantiated characteristics of sunspots are used, as, for instance, the frequency of sunspot formation and the average importance of sunspots (quantities the examination of which has already resulted in important physical conclusions), or the magnetic properties of sunspots, etc. Further research, restricted only to relative numbers and total areas of sunspots, will finally lead to stagnation in this field of solar research.

131.   Kopecký, M.,
        THE DEPENDENCE OF THE AVERAGE IMPORTANCE OF SUNSPOT
        GROUPS ON HELIOGRAPHIC LATITUDE AND THE PHASE OF THE
        11-YEAR CYCLE, Astronomical Institutes of Czechoslovakia, Bulletin,
        Vol. 13, 1962, pp. 63-67.

        Comparison of the "Butterfly Diagram" with the course of the diurnal average area of the spot groups shows considerable differences in the activities of these physically different characteristics during the activity cycle. It is further shown that the existence of Becker's second spot zone cannot be considered as yet to be definitely proven. The conclusions are summarized.

132.   Kopecký, M.,
        PHYSICAL INTERPRETATION OF THE 80-YEAR PERIOD OF SOLAR
        ACTIVITY, Astronomical Institutes of Czechoslovakia, Bulletin,
        Vol. 13, 1962, pp. 240-245.

        A complete review is given of all parameters of solar activity that have been proven to be subjected to the 80-year cycle, and the numerical values of these parameters during 11-year cycles 12 to 18 are tabulated. It is possible to explain some phenomena of the 80-year cycle in the frame work of Allen's spot theory (see item 2) by assuming that the cross section of the spot-generating magnetic toroids is subjected to an 80-year variation, while the magnetic flux remains constant. The variation is caused by changes in the gas temperature and the external gas pressure.

133.   Kopecký, M.,
       ABOUT THE PERIODICITY OF THE FREQUENCY OF FORMATION
       AND AVERAGE IMPORTANCE OF THE SUN-SPOT GROUPS,
       Riše Hvězd, Vol. 43, 1962, pp. 90-92 (In Czechoslovakian).

       Not abstracted.

134.   Kopecký, M. and Kuenzel, H.,
       THE HELIOGRAPHIC DISTRIBUTION OF SUNSPOT GROUPS
       OF DIFFERENT CLASSES IN THE 18TH ACTIVITY CYCLE,
       Astronomische Nachrichten, Vol. 286, 1962, pp. 193-195
       (In German).

       The sunspot areas are represented by lines of equal, mean spot
       area in a latitude-time diagram for the epoch 1944 to 1950.   This is
       compared with the percentage distribution of spot groups of
       classes A, B, and E, F, shown in two other diagrams.   It is found
       that the areas with greater than average spot area coincide with
       areas with greater than average spot concentration of spot-groups
       of the classes E and F.   Spot groups of the classes A and B show,
       on the average, lesser concentration in the same areas.   The
       findings are discussed.

135.   Kopecký, M.,
       ON BABCOCK'S DERIVATION OF SPÖRER'S LAW, Astronomical
       Institutes of Czechoslovakia, Bulletin, Vol. 14, 1963, pp. 231-234.

       Correction of an error of Babcock's in the derivation of Spörer's
       law (see item 9) makes it possible to explain by his model not only
       the migration of spot zones toward the equator but also their
       spreading toward the poles during the initial phase of the 11-year
       cycle.

136.   Kopecký, M.,
       ON THE QUESTION OF THE REALITY OF AN 80-YEAR PERIOD
       OF THE AVERAGE IMPORTANCE OF SUNSPOT GROUPS,
       Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 15, 1964
       pp. 44-48.

       Measurements made at Greenwich Observatory of the areas of
       sunspot groups in cycles 15 to 18 were analyzed by the author
       in order to distinguish between a possible systematic variation
       of the detection threshold for small groups in these observations
       and a real variation of the average area of these groups.   The latter
       phenomenon was confirmed.

137.   Kopecký, M.,
       HYDROMAGNETIC HYPOTHESES ON THE 80-YEAR SUNSPOT
       PERIOD, <u>Astronomical Institutes of Czechoslovakia, Bulletin</u>, Vol. 15,
       1964, pp. 178-186.

       Beginning with the hypotheses of Allen (item 2) and Babcock
       (items 9 and 10) and of the 22-year solar cycle, the author discusses
       the different, possible explanations for the coming about of the
       hydromagnetic properties of the sun.

138.   Kopecký, M.,
       THE PERIODICITY OF THE SUNSPOT GROUPS, <u>Advances in
       Astronomy and Astrophysics</u>, Vol. 5, 1967, pp. 189-266.

       The contents of this extensive survey are as follows:

         I. Introduction
        II. Resolution of the Wolf Number and the Spotted Area into
             Primary Parameters
       III. Methods of Determining the Number of Spot Groups Formed
             and Their Important Characteristics
        IV. Time Behavior of the Number of Spot Groups Formed and
             Their Average Importance
         V. Formation Frequency of Spot Groups and Their Importance
             in Dependence on Heliographic Latitude
        VI. General Conclusions
             References

139.   Kotov, V. A., Gudzenko, L. I., and Chertoprud, V. E.,
       ON THE SYNCHRONIZATION OF SOLAR ACTIVITY, <u>Astronomicheskii
       Tsirkulyar</u>, S.S.S.R., No. 331, 1965, pp. 1-2 (In Russian).

       An interpretation is presented of results of calculation of values
       of divers parameters obtained as functions of the phase ϑ of the
       activity cycle.

140.   Kotov, V. A., Gudzenko, L. I., and Chertoprud, V. E.,
       ON THE EQUATIONS OF THE CYCLIC ACTIVITY OF THE SUN,
       <u>Astronomicheskii Tsirkulyar</u>, S.S.S.R., No. 333, 1965, pp. 6-7
       (In Russian).

       The values of divers parameters describing the cycle are
       determined as function of the phase ϑ of the activity.

141.   Kozhevnikov, N. I.,
        TEMPORAL VARIATIONS IN AREA OF A SUNSPOT GROUP,
        Astronomicheskii Zhurnal, S.S.S.R., Vol. 41, 1964, pp. 934-936;
        Soviet Astronomy-AJ, Vol. 8, 1964-1965, pp. 747-749.

        It is shown that the area of a spot group increases in the same
        manner as the area of a section of a sphere rising in a liquid with
        constant velocity. The ascent velocity is proportional to the magnetic
        field strength of the group.

142.   Kozhevnikov, N. I. and Klyakotko, M. A.,
        DETERMINATION OF SOME LARGE-SCALE MOTION PARAMETERS
        IN THE SOLAR PHOTOSPHERE, Astronomicheskii Zhurnal, S.S.S.R.,
        Vol. 40, 1963, pp. 61-70; Soviet Astronomy-AJ, Vol. 7, 1963,
        pp. 44-50.

        The analysis of the results obtained by the authors (item 118)
        in elucidating the nature of the large-scale motions in the solar
        photosphere is given. It is found that the velocities $V(\varphi)$ may be
        represented, in the first approximation, in the form

        $$V(\varphi) = K\varphi + \alpha \sin \frac{2\pi\varphi}{T}.$$

        The variation of T detected and reported in item 118 is confirmed.
        The variability of K and α are studied in relation to the solar
        activity cycle. It is shown that K decreases toward the solar
        activity minimum and increases toward the solar activity maximum.
        The amplitude α increases toward the solar activity minimum. It
        is shown that the pattern of variation in the inclination of the zones
        lying toward the equator as a function of the phase of solar activity
        cannot account for these peculiar features.

143.   Krüger, A., Krüger, W., and Wallis, G.,
        THE TEMPORAL AND SPECTRAL BEHAVIOR OF THE SLOWLY
        VARYING COMPONENT OF SOLAR RADIO EMISSION DURING THE
        CURRENT SPOT CYCLE, Zeitschrift für Astrophysik, Vol. 59,
        1964, pp. 37-55 (In German).

        The spectral distribution and time dependency of the slowly
        varying component (s-component) of the sun during the years
        1954-1961 has been investigated statistically.

A correlation analysis based on single radio frequency measurements between $\lambda = 3.2$ and 56 cm and Zürich definite sunspot numbers has been carried out. The degree of accuracy attained by such radio observations has been studied critically. A consideration of some pecularities of different sources of the s-component is finally included.

144.　Kuenzel, H.,
STATISTICAL STUDY OF FREQUENCY, ZONE MIGRATION, AND LIFETIME OF SUNSPOTS DURING THE 18TH ACTIVITY CYCLE, Astronomische Nachrichten, Vol. 285, 1961, pp. 169-173 (In German).

The study included 3670 spot groups during the epoch 1944.2 to 1954.3. The groups were divided into classes according to frequency, zone migration, and lifetime. The class frequency decreased as the development progressed, but all classes had their brightness maximum in 1947. However, the centroids of the frequency distribution came later, but the delay was least for the most advanced classes. Zone migration of the spot-groups in the different classes followed closely one and the same trend, but took place in lower latitudes for the totality of the spot groups than was expected from the greatest, adjusted, monthly relative number according to the law of zone migration. The dwell times at the different stages of development were determined, and from these values the mean lifetime of each class was obtained. It appears that in every class, the dwell time increases with the progress toward the maximum, but that the dwell time at a given stage of development is smaller for the farther developed classes. The opposite was found to apply in the case of the decay phase.

145.　Kuleshova, K. F.,
THE FINE STRUCTURE OF THE SPOT-FORMATION ZONES, Astronomicheskii Zhurnal, S.S.S.R., Vol. 39, 1962, pp. 273-277; Soviet Astronomy-AJ, Vol. 6, 1962, pp. 213-216.

We have detected a meridional circulation at the photospheric level, directed from poles to equator. This effect manifests itself as a ring of spots which encircles the sun at high latitudes and drifts gradually toward the equator, reaching it 21 months after the spots first appear. Four to six months after the ring forms, another one appears at high latitude. Spörer's sunspot zone therefore breaks down into a series of consecutive individual pulses. The pulses are propagated at a rate of $d\phi/dt \approx 1°.2$ per month.

146. Legrand, J. P.,
      THE PREDECREASE OF COSMIC RAYS IN PERIODS OF
      MAXIMUM SOLAR ACTIVITY (APRIL 1957-DECEMBER 1958),
      Annales de Géophysique, Vol. 16, 1960, pp. 140-142 (In French).

      The cosmic-radiation predecrease event displayed during the
      continuous measurements carried out in the course of the
      International Geophysical Year revealed the presence of particularly
      active sunspots on the east limb of the sun. The author gives a
      description of this event accompanied by several examples of
      correlations.

147. Letfus, V.,
      LONG TERM VARIATION OF CHANDLER'S PERIOD AND SOLAR
      ACTIVITY, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 16,
      1965, pp. 370-371.

      Data of the International Service of Latitudes from 1899.9 to
      1959.2, Orlov's reductions for the interval from 1891.5 to 1957.4,
      and other data were used in a study of the variability of the amplitude
      of the movement of the terrestrial pole by a graphical method.

148. Link, F.,
      LONG-PERIOD VARIATIONS OF SOLAR ACTIVITY BEFORE THE
      17TH CENTRUY, Astronomical Institutes of Czechoslovakia, Bulletin,
      Vol. 14, 1963, pp. 226-231 (In French).

      A 400-year cycle and an 80-year cycle of solar activity are
      pointed out in the frequency of polar auroras from the fifth to the
      16th century.

149. Link, F.,
      THE 400-YEAR CYCLE OF SOLAR ACTIVITY, Zeitschrift für
      Astrophysik, Vol. 56, 1963, pp. 279-281 (In French).

      This article is a refutation of Gleissberg's remarks (see item 80)
      on the reality of the 400-year cycle of solar activity.

150. Link, F.,
      PLANETARY CONJUNCTIONS, MAGNETIC PERTURBATIONS,
      AND SUNSPOTS, Astronomical Institutes of Czechoslovakia, Bulletin,
      Vol. 15, 1964, pp. 114-115 (In French).

In order to preclude the possibility of trivial dependence of solar and geomagnetic activity on planetary position, the investigation of the hypothetical influence of Venus in inferior conjunction on corpuscular streams was expanded to superior conjunction. The periodic variations of the sunspot number R seem related to the synodic revolution of Venus. Similar results have been found for Mercury.

151. Loewe, F. and Radok, U.,
ON THE ANNUAL CYCLE IN THE SUNSPOT NUMBERS, Gerlands Beitraege zur Geophysik, Vol. 68, 1959, pp. 342-353.

The monthly averages of the sunspot relative numbers for the years 1867 to 1953 show an annual period with a summer maximum which was pointed out for the first time by L. A. Bauer, in 1921. If the frequency distribution of the spot relative numbers is brought into the Gaussian form by a square-root transformation, then the vector train formed by the individual, annual cycles shows a temporary persistence in the same vector direction. Only the curvature of the sunspot curve seems to be a tenable theory for the apparent annual period of the spot relative numbers, but the curvature is not constant, nor even is its sign. From this it is concluded that the annual period of the spot relative numbers is simply a result of the characteristic, continuous, oscillatory spectrum of auto-correlated series.

152. Lopez Arroyo, M.,
THE LONG CYCLE OF SOLAR ACTIVITY, Urania, Spain, Vol. 43, 1958, pp. 133-141 (In Spanish).

This article presents statistical researches on the 22-year cycle and on the possibility of a longer cycle in using as index the number of sunspots observed one single day during each 10-year cycle.

153. Lopez Arroyo, M.,
ON THE DISTRIBUTION OF SUNSPOTS IN HELIOGRAPHIC LONGITUDE, The Observatory, Vol. 81, 1961, pp. 205-207.

Using data for the solar cycles 12 to 18, the author made a preliminary study of the distribution of sunspots over the sun's surface. His aim was to see if there are regions in which activity through a cycle is greater than that in other regions and to study their features and movements.

154. Lopez Arroyo, M.,
      THE EVOLUTION OF THE AREA OF SUNSPOTS, Urania, Spain,
      Vol. 47, 1962, No. 255-256, pp. 19-29 (In Spanish).

      Investigation of the growth curves of the sunspots in cycles 14
      and 18 showed that there is no relation between the maximal area
      of the spots and their lifetime. The rate of decrease of the spot
      area increases with the lifetime. These results contradict the
      findings of previous studies.

155. Lopez Arroyo, M.,
      STUDY OF THE DISTRIBUTION OF THE MAXIMUM SURFACE OF
      SUNSPOTS, Astronomical Institutes of Czechoslovakia, Bulletin,
      Vol. 16, 1965, pp. 244-249 (In French).

      It is shown that in cycles 12 to 18 (from 1878 to 1954) the
      distribution can be considered as normally logarithmic. An attempt
      is made to find the 22-year cycle of magnetic phenomena by
      application of the tests of equality of variances and of equality of
      means.

156. Macris, C.,
      THE POSSIBLE VARIATION OF PHOTOSPHERIC GRANULES,
      The Observatory, Vol. 75, 1955, pp. 122-123.

      Observational data on the integrated area, photographic and
      visual contrast, and lifetimes of photospheric granules suggest a
      possible variation in phase with the 11-year sunspot cycle.

157. Macris, C. and Elias, D.,
      ON A VARIATION OF THE NUMBER OF PHOTOSPHERIC
      GRANULES AS A FUNCTION OF SOLAR ACTIVITY, Annales
      d'Astrophysique, Vol. 18, 1955, pp. 143-144 (In French).

      From measurements of 10 photographs of the solar disk, taken
      at irregular intervals between 1880 and 1943, it appears that a
      relation may exist between the number of granules on the total
      surface and the Wolf sunspot number R. The number of granules
      increased from 1.5×10^6 to 2.5×10^6, when R increased from 5 to
      100 respectively.

158. Mandrykina, T. L.,
THE DEVELOPMENT OF THE CURRENT SECULAR CYCLE OF
SOLAR ACTIVITY DURING THE PROGRESS OF THE 11-YEAR
CYCLE NO. 18, Lvov University, Astr. Obs., Tsirkulyar, No. 34,
1958, pp. 11-13 (In Russian).

The secular increase of both the spot-forming and the geomagnetic
activity of the sun continued during the 18th cycle.

159. Mandrykina, T. L.,
THE RELATION BETWEEN THE LIFETIME OF SUNSPOT GROUPS
AND THEIR AREAS, Lvov University, Astr. Obs., Tsirkulyar,
No. 34, 1958, pp. 14-15 (In Russian).

Between the lifetime of the sunspot groups and their maximum
areas, a positive correlation exists with r = 0.55 and r = 0.53, from
data of the Greenwich catalog (1900 to 1933) and of the Russian sun
observations (1934 to 1953) respectively.

160. Martres-Trope, M.-J.,
STATISTICAL STUDY OF THE DISTRIBUTION OF COMPLEX
SUNSPOT GROUPS, SUGGESTING A POSSIBLE CAUSE OF THEIR
FORMATION, Acad. Sci., Comptes Rendus, Vol. 259,
pp. 3445-3447 (In French).

A statistical determination has been made of the proportion of
magnetically complex sunspot groups as a function of latitude and
phase of the solar cycle.

161. Maxwell, A., Howard, W. E., III, and Garmire, G.,
SOME STATISTICS OF SOLAR RADIO BURSTS AT SUNSPOT
MAXIMUM, Journal of Geophysical Research, Vol. 65, 1960,
pp. 3581-3588.

· This article discusses the occurrence and intensity of solar
radio bursts at four frequencies in the band 100 to 600 Mc/sec.
The observations cover 4010 hours during a 12-month period at
sunspot maximum; the results refer essentially to bursts of intensity
greater than 10^{-21} mks unit and duration greater than 0.3 sec; and
the statistical information is interpreted in terms of the spectral
characteristics of the bursts. The experimental data were taken
at Fort Davis, Texas, and the analysis shows that at 125 Mc/sec
burst radiation was recorded for 560 hours of which 380 hours
were of low intensity. At 200 Mc/sec the burst radiation covered

350 hours, of which 240 hours were of low intensity. For these two frequencies, the bursts occurred mainly in the form of noise storms (spectral type I). At 425 and 550 Mc/sec, the total times of the solar bursts were much less, being 21 and 23 hours, respectively. For the most part, however, this radiation was of high intensity and appeared in the form of continuum radiation (spectral type IV) over a wide frequency range.

162. Mayot, Marcel,
THE PREDICTION OF SUNSPOTS, Annales d'Astrophysique, Vol. 10, 1947, pp. 222-236 (In French).

On the basis of Waldmeyer's publication of the monthly Wolf-numbers for the solar activity from 1749 to 1944, analytical expressions for the variation are developed. Comparison of the observed values with those predicted one and two years in advance during the interval 1844-1944, shows agreement with an absolute mean error of from 10 to 15 percent.

163. McNish, A. G. and Lincoln, J. V.,
PREDICTION OF SUNSPOT NUMBERS, American Geophysical Union, Transactions, Vol. 30, 1949, pp. 673-685.

A formula for predicting smoothed annual sunspot numbers is developed. A first approximation to the prediction of a future value in a cycle is the mean of all past values for that part of the cycle. This estimate can be improved by adding to the mean a correction proportional to the departure of earlier values of the cycle from the mean cycle. These correction factors are determined by the method of least squares. Sunspot data for 1834 through 1943 are used, and statistical reasons for rejecting data of earlier years are presented. Reliability of the method is discussed on the basis of the standard deviations of predictions made for each of the years of the ten cycles in question, using all the prediction formulas developed. The prediction of three-month means is also discussed.

164. McNish, A. G. and Lincoln, J. V.,
PREDICTION OF THE PRESENT SUNSPOT CYCLE, American Geophysical Union, Transactions, Vol. 35, 1954, pp. 709-710.

In this article the authors examine the reliability of their method for predicting smoothed annual sunspot numbers by comparing observational and predicted data for the then terminating cycle. The errors in the predictions were found to be approximately those anticipated in their earlier paper.

165.   Mergentaler, J.,
        CHARTS OF SOLAR ACTIVITY, Urania, Kraków, Vol. 29, 1958,
        pp. 279-282 (In Polish).

        On the average, the relation between spot area F and sunspot
        relative number R is described by F = 16.7R. The author found that
        this relation can be described better by the general formula
        $X = a + by + c \cos(\zeta + \varphi)$, where X is the spot area and y is the
        relative number.

166.   Mergentaler, J.,
        THE DEPENDENCE OF VARIOUS PARAMETERS OF SOLAR
        ACTIVITY ON THE PHASE OF THE ELEVEN-YEAR CYCLE,
        Acta Astronomica, Vol. 9, 1959, pp. 107-112 (In German).

        The relation between the area S of the sunspots and the Wolf
        relative numbers R was examined for seven cycles. A linear
        relation between R and the cycle phase angle was assumed, and the
        pertinent coefficient was calculated. The cycle activity is a function
        of the phase; this function has the shape of a loop.

167.   Miller, R. A.,
        INCLINED LINES OF SUNSPOT ACTIVITY, The Observatory,
        Vol. 81, 1961, pp. 95-98.

        K-line spectroheliograms often suggest that zones of sunspot
        activity are inclined to the solar equator. This suggestion is
        examined by carrying out a statistical analysis of 803 spots, weighted
        according to their area in square degrees, no spot having a weight
        of less than one. Ninety-five percent of the spots occurring in six
        regions are used in calculating 19 regression lines which are highly
        significant, and demonstrate the reality of slanted lines of sunspot
        activity for these regions. The locations of 172 arch-type
        prominences are also examined; 84 percent of these are found to lie
        wholly outside of the calcium faculae. Several of the roots of these
        prominences are located at the regression lines determined by the
        positions of the sunspots. It is concluded that, near sunspot
        maximum, there may exist slanted lines of activity possibly arising
        from extensive tubes of flux beneath the solar surface.

168.   Minnis, C. M.,
        AN ESTIMATE OF THE PEAK SUNSPOT NUMBER IN 1968, Nature,
        London, Vol. 186, 1960, p. 462.

48

From statistical studies of the sunspot curves since 1750 it is
concluded that the steadily increasing height (since the maximum of
1928) of the maximum values is still in the range of probable values
so that continuously increasing solar activity will not necessarily
take place. From the same deliberations follows a value between
110 and 160 for the height of the 1968 maximum.

169.   Minnis, C. M.,
        AN ESTIMATE OF THE PEAK SUNSPOT NUMBER IN 1968,
        Journal of Atmospheric and Terrestrial Physics, Vol. 20, 1961,
        pp. 94-99.

        An examination has been made of some statistical properties of
        the twenty peaks in the relative sunspot number which have occurred
        since 1750. The frequency distributions of R and ΔR and the
        autocorrelation function have made it possible to forecast the
        magnitude of the next peak which will probably occur in about 1968.
        It is concluded that there is a probability of at least 0 · 75 that this
        peak will lie in the range 110-160.

170.   Nadolschi, V.,
        SPATIAL GENERALIZATION OF THE STATISTICAL THEORY OF
        SUNSPOT GROUPS, Astronomical Institutes of Czechoslovakia,
        Bulletin, Vol. 10, 1959, pp. 161-164 (In Russian).

        A generalization of Kopecky's statistical theory of sunspots is
        presented. It is assumed that the visibility function is centrally
        symmetrical. Formulas are derived for the calculation of the ratio
        of all groups to the observed ones, and of the ratio of the number
        of all groups originating during a specified time, to the number of
        groups becoming visible during that time.

171.   Nemeth, T.,
        AN ATTEMPT TO THE EXPLANATION AND TO THE PREDICTION
        OF THE ELEVEN YEAR CYCLE OF SOLAR ACTIVITY, Pure and
        Applied Geophysics, Vol. 63, 1966, pp. 205-210.

        The joint effect of tides of Venus, Jupiter, and the earth is
        a decisive factor in the variations of the activity of sunspots. These
        three planets are repectively every 10.4 and every 12 years in
        conjunction; the average, 11.2 years, is nearly equal to the length
        of the mean solar cycle.

172.   Ol', A. I.,
        THE POSSIBLE PERIODICITY OF SOLAR ACTIVITY, Solar Data,
        No. 6, 1959, pp. 85-88 (In Russian).

        The existence of a strict periodicity of solar activity is confirmed.
        The occasional deviations are not accidental but are functions of the
        general level of solar activity. A table of the solar activity during
        the following cycles is appended.

173.   Ol', A. I.,
        THE POSSIBLE PERIODICITY OF SOLAR ACTIVITY, Astrono-
        micheskii Zhurnal, S.S.S.R., Vol. 37, 1960, pp. 222-226; Soviet
        Astronomy-AJ, Vol. 4, 1960, pp. 212-216.

        Newcomb's hypothesis that there is a strict periodicity with a
        period of 11 to 13 years underlying the solar-activity variations was
        verified, using more complete and recent data. The investigation
        showed the correctness of this hypothesis; the deviations of the
        observed epochs of the extrema of Wolf numbers from those computed
        on the basis of this hypothesis are not random, but depend on the
        general level of solar activity. Some of the derived correlations
        have been used for the prediction of the epochs of minimum and
        maximum of the next 11-year cycle of solar activity.

174.   Paghis, I.,
        REGULARITIES IN THE OCCURRENCE OF SOLAR FLARES, Nature,
        London, Vol. 202, 1964, pp. 992-994.

        This study pertains to the starting time of flares, regardless
        of their location on the solar disk, if they were listed by at least
        one observatory as of importance > 2. Two distinct types of time
        series were found: one is quasi-periodic, the other tends to increase
        regularly in consecutive integral multiples of the first interval of the
        series, and occurs always in association with one or more series
        of the first type. An interaction between the two series suggests
        itself particularly for "resonance" conditions, and a correlation
        between the dates of an intersection of the two series and of cosmic-
        ray events or other solar disturbances appears probable.

175.   Popovici, C. and Dinulescu, V.,
        SOLAR PHOTOSPHERIC ACTIVITY IN THE PERIOD 1955-1961,
        Studii Cerc. Astr. Seismol., Romania, Vol. 7, 1962, pp. 111-139
        (In Romanian).

Observational data obtained at Bucharest and other observatories are reviewed, and the epoch of the maximum of the 19th cycle is discussed.

176.   Ramanathan, A. S.,
        DISTRIBUTION OF SUNSPOTS IN HELIOGRAPHIC LONGITUDE,
        The Observatory, Vol. 82, 1962, pp. 254-256.

        Study of the distribution of sunspots over heliographic longitudes in four different latitude belts during the 16th and 17th sunspot cycle did not reveal a meridional drift of the activity areas. This is in contrast to M. Lopez Arroyo's findings (item 153). It appears that the drift was simulated by disregarding the differential rotation of the photosphere.

177.   Ramanathan, A. S. and Jayanthan, R.,
        DISTRIBUTION OF SUNSPOTS IN LONGITUDE, Kodaikanal
        Observatory, Bulletin, No. 160, 1962.

        For the epoch from 1889 to 1954 (6 sunspot cycles), the mean spot areas (corrected for perspective foreshortening) are plotted as functions of their heliographic latitudes (corrected for differential rotation). The distribution of the sunspot activity by longitude shows that the centers of the spot activities have meridional structure. An occasional migration in heliographic longitude by individual centers has been observed, but extent and direction of the migrations vary.

178.   Ramanathan, A. S. and Natarajan, V.,
        SOME CHARACTERISTICS OF SUNSPOT ACTIVITY WITHIN A
        CYCLE, The Observatory, Vol. 85, 1965, pp. 188-190.

        Results are given of an analysis of the longitudinal and latitudinal displacements of individual spot groups during cycle 17. The discussion of the results is based on the hypothesis about the formation of spots near the photosphere.

179.   Rima, A.,
        REVIEW OF THE 11-YEAR PERIOD OF SOLAR PHENOMENA,
        Geofisica e Meteorologia, Vol. 9, 1961, pp. 39-46 (In Italian).

        Statistical analysis of the annual average numbers of sunspots by the method of Stumpf, or by analysis of periods according to

Labrouste and Vercelli, has given evidence of the existence of wave periods of 2, 3, 4.1, 5.6, 8.3, 11.2, 16, 22, and 35 years. Waves with periods of less than 11.2 years are regular and continuous, while those with periods longer than 11.2 years are discontinuous during the interval 1749-1956.

180.   Ringnes, T. S. and Jensen, E.,
        ON THE RELATION BETWEEN MAGNETIC FIELDS AND AREAS
        OF SUNSPOTS IN THE INTERVAL 1917-1956, Astrophysica
        Norvegica, Vol. 7, 1960, pp. 99-121.

        This article presents a comparison of the data with three
        formulas; the logarithmic formula was the best. No systematic
        change of coefficients with time was noted. Frequency of sunspots
        with strong magnetic fields is presented.

181.   Ringnes, T. S.,
        SECULAR VARIATIONS IN SHORT-LIVED SUNSPOTS, Astrophysica
        Norvegica, Vol. 8, 1962, pp. 17-52.

        Statistical study of the one-day groups recorded in the
        Greenwich Photoheliographic Results for 1879 to 1957 within less
        than 65 degrees from the central meridian. The 80-year cycle
        shows up besides the 11-year cycle in frequency and north-south
        asymmetry. The variations are connected with the secular changes
        in the relation between magnetic-field strength and area of sunspots.

182.   Ringnes, T. S.,
        SECULAR VARIATIONS OF INTERMITTENT AND REVIVAL
        SUNSPOT GROUPS, Astrophysica Norvegica, Vol. 8, 1963,
        pp. 127-159.

        Secular variations, distinct from the 11-year period, are found
        in number, composition, and other features of intermittent and
        revival sunspot groups.

183.   Ringnes, T. S.,
        SECULAR VARIATIONS OF SUNSPOTS WITH LIFETIMES FROM
        TWO TO EIGHT DAYS, Astrophysica Norvegica, Vol. 8, 1964,
        pp. 161-203.

Sunspot groups with lifetimes from 2 to 8 days which were born and decayed within 60 degrees from the central meridian have been studied in terms of features such as number, the increase in mean and maximum area with lifetime, and the dependence of area on age for groups of a given lifetime. The period under study, 1884 to 1958, has been considered as a whole, but individual cycles have also been studied. Several secular variations have been found.

184.   Ringnes, T. S.,
        SECULAR VARIATIONS OF LONG-LIVED SUNSPOTS, Astrophysica
        Norvegica, Vol. 8, 1964, pp. 303-340.

        Number and area distribution of spot groups of intermediate and
        long lifetimes have been studied in the period 1889 to 1954, as well
        as the area development curves of individual long-lived spots in the
        period 1914 to 1954. Eigenson's recurrence indices have been
        revised, and various secular variations have been found.

185.   Ringnes, T. S.,
        ON THE LIFETIME OF SUNSPOT GROUPS, Astrophysica Norvegica,
        Vol. 9, 1964, pp. 95-101.

        A study is made of the age-frequency distribution of sunspot
        groups. The analysis covers the interval 1888 to 1955.

186.   Ringnes, T. S.,
        SECULAR VARIATIONS OF SHORT-LIVED SUNSPOTS, Nature,
        London, Vol. 192, 1966, pp. 151-152.

        This article presents examples of these variations found in the
        results of Greenwich photo-heliographs from 1879 to 1957.

187.   Romanchuk, P. R.,
        ON THE ANNUAL VARIATION OF SOLAR ACTIVITY, Geofizika
        i Astronomiya, Ukrain. S.S.R., No. 5, 1963, pp. 248-256
        (In Russian).

        It has been found that the annual variation of solar activity can
        not be tied to the atmospheric conditions during observation of the
        spots. A hypothesis is proposed according to which the variations
        of the activity in the course of the year are caused by mutual
        influence of planets.

188.   Romanchuk, P. R.,
        THE MAXIMUM AND THE DURATION OF CYCLE NO. 20,
        Astronomicheskii Tsirkulyar, S.S.S.R., No. 351, 1965,
        pp. 2-4 (In Russian).

        The author attempts to predict the activity of cycle No. 20
        from his correlations of the character of cycles of solar activity
        and of the positions of planets.

189.   Romanchuk, P. R.,
        THE PROBLEM OF THE NATURE OF SOLAR ACTIVITY, Solar Data,
        1965, No. 11, pp. 66-70 (In Russian).

        This article is a study of the role of the general field of the sun
        and of planetary effects during quadrature and conjunction in the
        process of formation of sunspots.

190.   Saiko, V. I.,
        THE RELATIONSHIP BETWEEN THE NUMBER OF SPOTS IN A
        GROUP AND ITS AREA, AND THE CYCLIC CHANGES OF THIS
        RELATIONSHIP, Lvov University, Astr. Obs., Tsirkulyar, No. 29,
        pp. 21-24 (In Russian).

        A close statistical relationship between the number of individual
        spots (n) and the total area (S) of spot groups was found by an
        examination of the first 50 and 100 spot groups during the years from
        1938 to 1951. The correlation coefficient increases with the solar
        activity.

191.   Schmied, L.,
        RELATION BETWEEN THE ZONE WIDTH OF SUNSPOT OCCURRENCE
        AND THE RELATIVE NUMBER, Astronomical Institutes of
        Czechoslovakia, Bulletin, Vol. 13, 1962, pp. 246-247.

        The author presents evidence of a statistical relation based on
        his observations during the period from 1951 to 1961.

192.   Schnur, G. and Wagner, G.,
        OBSERVED AND ADJUSTED MEAN ROTATIONS OF THE RELATIVE
        SUNSPOT NUMBERS FOR THE YEARS 1832-1964, Astronomische
        Nachrichten, Vol. 288, 1965, pp. 219-232 (In German).

        The mean Wolf numbers were calculated for the 27-day rotation
        periods Nos. 0 to 1797, used by geophysicists.

193.   Schove, D. J.,
        THE SUNSPOT CYCLE, 649 B.C. TO A.D. 2000, Journal of
        Geophysical Research, Vol. 60, 1955, pp. 127-146.

        From the observations of spots since 1700, of maxima and
        minima since 1610, and of auroras since 300, the sequence of sunspot
        cycles (maximum and minimum years, maximum intensity) since
        the year -650 is extrapolated. From aurora observations it appears
        that an irregular cycle of about 200 years exists besides the 11- and
        78-year cycles.

194.   Schove, D. J.,
        SUNSPOT MAXIMA SINCE 649 B.C., British Astronomical
        Association, Journal, Vol. 66, 1956, pp. 59-61.

        Not abstracted.

195.   Shapiro, R. and Ward, F.,
        A NEGLECTED CYCLE IN SUNSPOT NUMBERS?, Journal of the
        Atmospheric Sciences, Vol. 19, 1962, pp. 506-508.

        The recently discovered oscillation of the zonal wind component
        in the equatorial stratosphere of slightly more than 2 years in length
        may be due to variations in solar ultraviolet radiation. The authors
        reexamine the variance spectrum of the monthly Zürich relative
        sunspot number. There appears to be a small peak in this spectrum
        at a 25-month period. However, the statistical evidence is not in
        itself conclusive, and the lack of a pronounced 11-year cycle in the
        equatorial stratosphere is difficult to understand.

196.   Shapiro, R.,
        THE INHERENT SMOOTHING OF WHOLE-DISK SOLAR INDICES,
        Journal of Geophysical Research, Vol. 70, 1965, pp. 245-246.

        The purpose of this smoothing is the elimination of phenomena
        of long duration in order to study the short-periodic variations.

197.   Shapiro, R.,
        COMPARISONS OF POWER SPECTRUMS OF ARTIFICIAL TIME
        SERIES WITH SPECTRUM OF A SOLAR PLAGE INDEX, Journal of
        Geophysical Research, Vol. 70, 1965, pp. 3581-3586.

        This type of comparison shows that it is very difficult to
        separate by this method active regions from each other by longitude.

198.   Sheeley, N. R., Jr.,
        POLAR FACULAE DURING THE SUNSPOT CYCLE, Astrophysical
        Journal, Vol. 140, 1964, pp. 731-735.

        A critical review of observations of North- and South-polar
        faculae has shown that there is a variation of the numbers of polar
        faculae with time, approximately 180 degrees out of phase with the
        time variation of the sunspot number for the whole disk.   If the
        number of polar faculae and the number of sunspots are plotted with
        consideration of the polarities, a 90 degree shift between the curves
        is found in agreement with Leighton's hypotheses.

199.   Shibata, H.,
        A METHOD OF DETERMINING OF CORRELATION BETWEEN
        f_0 F2 AND SUNSPOT NUMBER, Journal of the Radio Research
        Laboratories, Tokyo, Vol. 5, 1958, pp. 65-73.

        Not abstracted.

200.   Suda, T.,
        SOME STATISTICAL ASPECTS OF SOLAR ACTIVITY INDICES,
        Meteorological Society of Japan, Journal, Vol. 40, 1962, pp. 287-299.

        Characteristics of some indices and their relations are
        investigated, especially those of the sunspot numbers and the
        magnetic index C, of planetary tides and of solar activity.   The
        duration of the solar cycle is discussed.

201.   Szymánski, W.,
        CHANGES IN THE 80-YEAR CYCLE OF SOLAR ACTIVITY,
        Urania, Kraków, Vol. 28, 1957, pp. 268-273 (In Polish).

        The solar activity since the year 1610 is analyzed, and it is found
        that the 80-year cycle lasts 84.5 years.

202.   Szymánski, W.,
        SURFACE OF SUNSPOTS AND THE WOLF NUMBER, Urania,
        Kraków, Vol. 29, 1958, pp. 311-313 (In Polish).

        In this article, the author shows that the proportionality factor
        between sunspot relative numbers and spot area is variable.

203. Szymański, W.,
   PERIODIC CHANGES OF THE LENGTH OF THE CYCLE OF SPOT
   CAUSES ON THE SUN, Urania, Kraków, Vol. 29, 1958, pp. 313-315
   (In Polish).

   This article presents the author's comments on the periodic
   changes of the sunspot activity.

204. Szymański, W.,
   WHEN WILL THE NEXT SUNSPOT MINIMUM OCCUR?, Urania,
   Kraków, Vol. 33, 1962, pp. 339-340 (In Polish).

   The author concludes that the 19th sunspot cycle will last for
   about 14 years, and that the sunspot minimum is to be expected for
   about 1968.

205. Szymański, W.,
   IS THIS A "MILLENIUM CYCLE"?, Urania, Kraków, Vol. 35, 1964,
   pp. 279-281 (In Polish).

   In March 1964 the author observed the first spot group
   belonging to the new, 20th cycle. He compares 12 groups of the
   19th cycle with nine of the 20th, and he supposes that the 20th
   cycle will be more active than the preceding one.

206. Takakura, T. and Ono, M.,
   YEARLY VARIATIONS IN ACTIVITIES OF OUTBURSTS AT
   MICROWAVES AND FLARES DURING A SOLAR CYCLE WITH
   SPECIAL REFERENCE TO UNUSUAL COSMIC RAY INCREASES,
   Physical Society of Japan, Journal, Supplement A-II, 1962,
   pp. 207-210.

   An investigation was made of the unusual increases of cosmic
   rays, occurring before and after but not during sunspot maxima.
   The most intensive microwave bursts which apparently represent
   well the acceleration of particles in the solar atmosphere show the
   same trend although during the maximum flares of importance 3+ are
   the most frequent. It seems probable that the increases in cosmic
   radiation originate in the sun, and are not caused by interplanetary
   modulation.

207.   Thüring, B.,
A ONE-PARAMETER FORMULA FOR SUNSPOT FREQUENCY,
Astronomische Nachrichten, Vol. 282, 1955, pp. 33-38 (In German).

Beginning with generalized physical concepts, the author developed deductively a one-parameter formula for the fundamental course of the sunspot frequency. Its constant parameters were numerically determined from sunspot statistics. Sunspot statistical data were compared with the formula.

208.   Tlamicha, A., Křivský, L., and Olmr, J.,
CLASSIFICATION OF SOLAR RADIO STORMS IN THE METRE RANGE AND THEIR FREQUENCY 1959-1961, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 15, 1964, pp. 49-52.

From the observations made at Ondřejov from 1959 to 1961 at $\lambda = 130$cm a tentative new classification based on progress and intensity of radio bursts was established. The statistical frequency of the five classes $N_A \ldots N_E$ and their relations to the conventional classes I to IV are given.

209.   Tlamicha, A. and Olmr, Jr.,
CATALOGUE OF 231MHz SOLAR RADIO NOISE STORMS (ONDŘEJOV 1959-1961), Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 15, 1964, pp. 133-137.

Not abstracted.

210.   Toman, K.,
FOURIER TRANSFORM OF THE SUNSPOT CYCLE, Journal of Geophysical Research, Vol. 71, 1966, pp. 3285-3286.

Application of this mathematical technique in the determination of the duration of the sunspot cycle is described.

211.   Torelli, M.,
SOME ASPECTS OF THE CURRENT SOLAR CYCLE DEDUCED FROM OBSERVATIONS MADE AT THE ASTRONOMICAL OBSERVATORY OF ROME BY M. MARIO, Societa Astronomica Italiana, Memorie, Vol. 31, 1961, pp. 497-514 (In Italian).

This article presents considerations of the current solar cycle. It is the most active cycle which has been seen for a long time.

The possible existence of a cycle of longer period (about 88 to 90 years) is presented. Predominance of activity in the northern hemisphere is noted, and numerous tables and graphs are included.

212.   Torrisi, S.,
        SOLAR ACTIVITY DURING 1963, Societa Astronomica Italiana, Memorie, Vol. 35, 1964, pp. 59-73 (In Italian).

        The results of the traditional solar observations made at Catania during 1963 are given. These observations are both photospheric (spots, pores, and faculae) and spectroscopic (prominences and height of the chromosphere). The results are briefly compared with those of the previous years of the cycle.

213.   Trellis, M.,
        AXIS OF SYMMETRY OF THE ROYAL ZONES OF THE SUN, Acad. Sci., Comptes Rendus, Vol. 256, 1963, pp. 2300-2302 (In French).

        A method is presented for determination of this axis and of its daily sidereal rotation about Carrington's axis of rotation.

214.   Trellis, M.,
        THE INFLUENCE OF HELIOGRAPHIC LATITUDE ON THE GROWTH OF SUNSPOT AREAS, Acad. Sci., Comptes Rendus, Vol. 256, 1963, pp. 3588-3591 (In French).

        Recent work by Trellis has shown that the axis of symmetry of the so-called "royal zones" makes an angle of ~0.5 degrees with the solar rotation axis. The effects of such asymmetry on the latitude/area relationship for developing spot groups is now considered, and the results are briefly discussed.

215.   Trellis, M.,
        DISTRIBUTION OF CORONAL JETS AS A FUNCTION OF LATITUDE DURING A SOLAR CYCLE, Acad. Sci., Comptes Rendus, Vol. 257, 1963, pp. 52-53 (In French).

        The occurrence of coronal jets (observed at λ 5303 A) over two complete, and part of a third, solar cycles is plotted against solar latitude. While the main features are similar in solar cycles XVIII and XIX, a number of dissimilarities are noted. It is pointed out that a new cycle apparently begins at the poles several years before the previous cycle has ended at the equator.

216. Trellis, M.,
SOLAR TIDES OF PLANETARY ORIGIN, Acad. Sci., Comptes Rendus, Vol. 262, 1966, Ser. B, pp. B221-B224 (In French).

In this article the amplitudes of tides are evaluated that may form on the surface of the sun under the influence of the different planets.

217. Trellis, M.,
ON A POSSIBLE RELATION BETWEEN THE AREA OF SUNSPOTS AND THE POSITION OF PLANETS, Acad. Sci., Comptes Rendus, Vol. 262, 1966, Ser. B, pp. B312-B315 (In French).

The spot area seems to depend on the planetary positions, and to be greater when the latter result in high tides.

218. Trellis, M.,
INFLUENCE OF THE CONFIGURATION OF THE SOLAR SYSTEM ON THE FORMATION OF ACTIVITY CENTERS, Acad. Sci., Comptes Rendus, Vol. 262, 1966, Ser. B, pp. B376-B377 (In French).

A much greater number of spot groups forms in the regions where tides of planetary origin are high than in those where the tides are low.

219. Trotter, D. E. and Billings, D. E.,
LONGITUDINAL VARIATION OF A ZONE OF SOLAR ACTIVITY, Astrophysical Journal, Vol. 136, 1962, pp. 1140-1144.

The solar differential rotation was found to be a more superficial phenomenon than solar activity. Since the data covered both the end of one cycle and the beginning of the next, the possibility of a persistent longitudinal zone activity extending through one spot cycle to another was looked for. No indication of such persistence was found.

220. Tuominen, J.,
ON THE LATITUDE DRIFT OF SUNSPOT GROUPS, Zeitschrift für Astrophysik, Vol. 51, 1961, pp. 91-94.

The latitude drift of short lived sunspot groups is studied separately for sunspot maxima and minima. The drift is shown to depend in a similar way on the latitude as, according to U. Becker, is the case of long-lived groups. For the maxima, it is possible

to interpret the drift as directed away from the center of the spot zone. It is not equally easy to apply the same interpretation to the minima.

221. Tuominen, J.,
ON THE LAYER OF THE SUN IN WHICH SUNSPOTS ARE GENERATED, Zeitschrift für Astrophysik, Vol. 55, 1962, pp. 110-112.

Using the positions of sunspots given in GREENWICH PHOTO-HELIOGRAPHIC RESULTS, the regions of formation of new sunspot groups are investigated. A statistical method resembling the one used by U. Becker is applied. In accordance with his result for selected areas rich in spots, called by him "Herde," it is shown generally that, if the solar period of rotation is determined not from spots (recurrent or nonrecurrent), but from the positions at which new spots are formed, the sun is found to rotate about 1 degree per day faster than the value derived from the spots. Hence, new spot groups develop in close proximity of the old ones but predominantly on their preceding side.

Although new sunspots are preferably produced near the places where sunspots already existed, no physical basis is found according to which sunspot groups could be divided into those belonging to "Herde" and those occurring individually. There is no indication that spots in "Herde" areas would come from a point source relatively deep beneath the photosphere.

The results of the investigation seem to be in accordance with the assumption that sunspots are produced in close proximity of the photosphere and that their average movements represent, partly at least, the large-scale motion at the photospheric level.

222. Urbanik, K. and Zieba, A.,
PREDICTION OF SOLAR ACTIVITY, Archiwum Elektrotechniki, Vol. 5, pp. 355-364 (In Polish).

The predictability of the relative numbers characterizing the sunspots is investigated. It is assumed that the variations are random, so that probability methods can be applied. The Kolmogorov-Wiener linear prediction is dealt with primarily, but is found to be inapplicable because of the required large number of observational data in the present case. Therefore, a simpler method is developed, based on the theory of the decision functions.

223.   Vasil'eva, G. I.,
         PHENOMENA OBSERVED IN THE PHOTOSPHERE IN THE REGION
         BENEATH A FLOCCULUS BEFORE THE APPEARANCE OF SUN-
         SPOTS, Izvestiya Astr. Glavn. Obs., Pulkovo, Vol. 23, 1963,
         pp. 3-16 (In Russian).

         On 20 June 1961 the sun magnetograph of the Pulkovo Observatory
         recorded an acceleration to 2km/sec within two minutes of the
         photospheric gas in the range of a magnetic-field maximum of
         100 gauss. The disturbance, which originated in the center of the
         maximum, spread from the site of the "explosion" eastward at a
         speed of 50km/sec and westward at a speed of 280km/sec. Because
         of the "explosion" the speed of the background fluctuated with a
         period of 5 min and an amplitude of 400 meter/sec; this is related
         to the existence of sound waves in the photosphere. The observation
         was made in an area of the photosphere far from sunspots; three
         days later, spots formed in the observed area.

224.   Venkatesan, D.,
         SOLAR ACTIVITY AND TRANSIENT DECREASES IN COSMIC-
         RAY INTENSITY, Journal of Geophysical Research, Vol. 64,
         1959, pp. 505-520.

         The world-wide character of the intensity changes in meson and
         nucleon components is shown by a study of data from Ottawa,
         Churchill, and Resolute during the period October 1956 to
         December 1957. Further discussion is essentially restricted to the
         mean nucleonic component derived from the three stations. The
         investigation reveals an association between transient decreases
         in cosmic-ray intensity and the central meridian passage of active
         solar regions. On an average, the greater the activity rating of
         the regions, the larger is the cosmic-ray decrease. It is not
         possible, however, to discuss the relation specifically in terms of
         the characteristics of the regions, such as flares, sunspots, and
         the like. Further support for the relation comes from observation
         of geomagnetic data. Attention is drawn to the similarity between
         small as well as large transient decreases in intensity with regard
         to presence or absence of recurrence tendency. The study supports
         the view that both the 27-day variation and the Forbush events differ
         only in degree and could therefore be attributed to the same
         mechanism. It is possible to attribute the cosmic-ray decreases to
         beams of ionized rarified gas emitted from the sun and differing
         considerably in their characteristics.

225. Visser, S. W.,
THE COMING SUNSPOT MAXIMUM, Hemel en Dampkring, Vol. 54, 1956, pp. 140-142 (In Dutch).

The author concludes, from a comparison of the monthly averages of the sunspot relative numbers in the cycles with strong solar activity since 1750, that the maximum of the 19th cycle will probably occur during August 1957, and that strong activity is to be expected up to a secondary maximum after about 1 year.

226. Visser, S. W.,
BEHAVIOUR OF THE PRESENT SUNSPOT CYCLE, Nature, London, Vol. 182, 1958, pp. 253-254.

By means of 27.2753-day running averages, the Zürich spot-number data from 1899 to March 1958 have been smoothed, and a new curve constructed to show the spot activity over the entire period. From this, it has been possible to predict some features of the present cycle. The primary maximum occurred in October 1957. Predictions are also made of two secondary maxima, the first between June and August 1958, and the second in October 1959.

227. Visser, S. W.,
A NEW ANALYSIS OF SOME FEATURES OF THE 11-YEAR AND 27-DAY CYCLES IN SOLAR ACTIVITY AND THEIR REFLECTION IN GEOPHYSICAL PHENOMENA, Kongl. Nederl. Meteorol. Inst. Med. Verh., No. 75, 1959.

Not abstracted.

228. Vitels, L. A.,
THE SOLAR INDEX $\bar{a}$, Lvov University, Astr. Obs., Tsirkulyar, No. 34, 1958, pp. 3-10 (In Russian).

The index $\bar{a}$ of solar activity (Eigenson, 1940) is the average number of spot groups appearing during one year. The meaning of this number and its relation to other indices of solar activity are discussed.

229. Vitinskii, Yu. I.,
APPLICATION OF MAYOT'S METHOD FOR THE ADVANCE COMPUTATION OF THE MEAN, MONTHLY SMOOTHED WOLF RELATIVE NUMBERS, Solar Data, No. 1, 1955, pp. 106-111 (In Russian).

Not abstracted.

230. Vitinskii, Yu. I.,
A PECULIARITY OF RECURRING SUNSPOT GROUPS, Solar Data,
No. 6, 1958, pp. 74-76 (In Russian).

This article concludes that the indices of maximum area and
lifetime of recurring sunspot groups are not constant.

231. Vitinskii, Yu. I.,
SOME PECULIARITIES OF THE DISTRIBUTION IN LONGITUDE
OF SOLAR ACTIVITY, Izvestiya Astr. Glavn. Obs., Pulkovo,
Vol. 21, 1960, pp. 96-105 (In Russian).

This article presents an application of a method of isolines in
establishing synoptic solar charts for a cycle. This method allows
recognizing the active regions on the sun. The presence of active
longitudes is confirmed; the principal population being the recurrent
groups. The index of magnetic i of the sunspots is not suitable for
the study of the distribution in longitude. Discussion of
characteristics of recurrent groups of active longitudes.

232. Vitinskii, Yu. I. and Ikhsanov, R. N.,
DETERMINATION OF THE EPOCHS OF THE EXTREMES OF THE
SUNSPOT CYCLES, Solar Data, No. 1, 1960, pp. 71-75 (In Russian).

Not abstracted.

233. Vitinskii, Yu. I.,
METHODS FOR MIDDLE-RANGE FORECASTS OF SOLAR
ACTIVITY, Izvestiya Astr. Glavn. Obs., Pulkovo, Vol. 21, No. 4,
1960, pp. 88-95 (In Russian).

This article discusses the principles of methods based on
Mayot's work, presented in Annales d'Astrophysique, Vol. 10,
1947, pp. 222-236.

234. Vitinskii, Yu. I.,
METHOD FOR THE FORECAST OF THE QUARTERLY WOLF
NUMBER, Astronomicheskii Zhurnal, S.S.S.R., Vol. 38, 1961,
pp. 714-725; Soviet Astronomy-AJ, Vol. 5, 1961, pp. 542-549.

In this article methods are given for predicting quarterly Wolf numbers for the following quarter, 2 quarters ahead, and for the declining branch of the current cycle of solar activity. The first two types of prediction are based on the regression method and Mayot's method for the prior calculation of half-yearly and quarterly relative sunspot numbers. An epignosis carried out by these methods results in a relative standard deviation of the order of 20-25 percent. The analog method, which is a modification of the Herrinck method, is used to predict quarterly Wolf numbers on the declining branch. Predictions obtained by this method are also found to be satisfactory, but the Wolf numbers calculated for 1964 to 1965 are apparently too high. In conclusion, some remarks are made concerning the intensity of the following 20th cycle of solar activity.

235.   Vitinskii, Yu. I.,
THE MANIFESTATION OF THE 11-YEAR CYCLE OF SUNSPOTS
IN DIFFERENT SOLAR LONGITUDE INTERVALS, Izvestiya
Astr. Glavn. Obs., Pulkovo, Vol. 22, 1962, pp. 111-119 (In Russian).

A statistical investigation was made of the change in the sunspot activity in 40-degree-heliographic longitude intervals during seven sunspot cycles. The northern and the southern hemispheres were reviewed separately. It was found that longitude intervals persist often for two or more cycles, if the activity in the intervals varies with the 11-year spot cycle. The same applies to intervals with particularly heavy activity. The activities in the longitude intervals do not develop synchronously. Development of spots in one hemisphere proceeds in a direction opposite to the development of spots in the other.

236.   Vitinskii, Yu. I.,
PECULIARITIES IN THE DEVELOPMENT OF THE 11-YEAR CYCLE
IN SPECIFIC LONGITUDE INTERVALS OF THE SUN, Solar Data,
No. 2, 1962, pp. 66-72 (In Russian).

Not Abstracted.

237.   Vitinskii, Yu. I.,
PECULIARITIES OF THE SPOT-FORMING SUN ACTIVITY IN THE
CURRENT 11-YEAR CYCLE, Solar Data, No. 7, 1962, pp. 66-75
(In Russian).

Not abstracted.

238.   Vitinskii, Yu. I.,
        THE FLUCTUATIONS OF THE SUNSPOT RELATIVE NUMBERS
        DURING THE CURRENT 11-YEAR CYCLE, Solar Data, No. 11,
        1962, pp. 56-58 (In Russian).

        The fluctuations are systematically greater than during the pre-
        ceding cycle. The trend during the 19th cycle is comparable to that
        during the ninth cycle; this applies especially to the ascending and
        descending phases.

239.   Vitinskii, Yu. I. and Ikhsanov, R. N.,
        THE CHARACTER OF THE GROWTH OF SUNSPOT GROUPS,
        Solar Data, No. 7, 1964, pp. 66-75 (In Russian).

        The temporal development of normalized spot group areas was
        investigated in retrospect with reference to the day of their maximum.
        At least three different types were found, for which the criteria
        are the maximal distance of the principal spots of the group and the
        duration of the growth, but not the maximum area itself. The
        increase of the group area with the fourth power of the time was
        found with only a few groups having a distance less than five degrees.

240.   Vitinskii, Yu. I.,
        ON THE CHARACTER OF THE VARIATION OF SOLAR ACTIVITY
        IN SEPARATE LATITUDE INTERVALS, Solar Data, No. 11, 1965,
        pp. 62-66 (In Russian).

        The peculiarities of the solar cycle were examined with methods
        of mathematical statistics (quantitative aspect of the problem). The
        difference of variation of activity indices in the intervals was
        established.

241.   Vitinskii, Yu. I.,
        THE ROLE OF THE HELIOGRAPHIC LATITUDE FACTOR ON THE
        VARIATION OF THE LEVEL OF SOLAR ACTIVITY, Solar Data,
        No. 12, 1965, pp. 53-56 (In Russian).

        The influence of the phase of the 11-year cycle and of the
        heliographic latitude on the variation with time of the number of spot
        groups and of the total surface was evaluated.

242.   Vostry, J.,
A NOTE ON TUOMINEN'S MODIFICATION OF BABCOCK'S THEORY OF THE SOLAR MAGNETIC FIELD, <u>Astronomical Institutes of Czechoslovakia, Bulletin</u>, Vol. 17, 1966, pp. 366-369.

Taking into consideration Gleissberg's law of the migration of the spot formation zone toward the equator, the author discusses the modification proposed by Tuominen.

243.   Waldmeier, M.,
THE LONG SUNSPOT CYCLE, <u>Zeitschrift für Astrophysik,</u> Vol. 43, 1957, pp. 149-160 (In German).

The well-known 11-year variation of solar activity shows maxima of very different heights. Low maxima are followed by high ones with a period of about 80 years. This same period is found in the variation of the asymmetry of sunspot-activity between the northern and the southern hemisphere. In addition, the phase-shift between the activity of the two hemispheres is subjected to the same period. The curves for the phase-shift and the intensity of solar activity are running in the same way, whereas the north-south asymmetry is largest when no phase-shift occurs, and vanishes when the phase-shift reaches its lowest or highest value.

244.   Waldmeier, M.,
FORM AND EXTENT OF THE MONOCHROMATIC CORONA, <u>Zeitschrift für Astrophysik,</u> Vol. 50, 1960, pp. 35-47 (In German).

More than 12,000 height measurements of the corona from 1939 to 1959 were subjected to a statistical analysis. The greatest coronal heights were found over active zones (spots and flares), increasing with solar activity but lagging about two years in the equatorial zone.

245.   Wallis, G., Krüger, W. and Krüger, A.,
STATISTICS OF THE SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION DURING THE PRESENT SPOT CYCLE, <u>Akademie der Wissenschaften, Deutsche, Montsberichte,</u> Vol. 5, 1963, pp. 684-688 (In German).

The relation between the spot relative number R and the radiation flux S of the slowly varying component of solar radio emission is statistically analyzed as a function of the wavelength.

The increase a_ν of the regression $S_\nu = b_\nu + a_\nu R$ has a maximum at $\lambda = 10\text{cm}$; further, the correlation is closest at 10.7cm. The method may make it possible to derive information about the temporal variation of the undisturbed basic radiation.

246.   Ward, F. and Shapiro, R.,
DECOMPOSITION AND COMPARISON OF TIME SERIES OF INDICES OF SOLAR ACTIVITY, Journal of Geophysical Research, Vol. 67, 1962, pp. 541-554.

Time series of a number of solar-activity parameters are subjected to a generalized harmonic analysis. This analysis allows the separation and comparison of phenomena which happen over a wide spectrum of time scales. It also allows comparison of variations on similar time scales in two different parameters. The analyses show, e.g., that the correlation between radio noise at 2800 Mc/sec and the Greenwich sunspot areas is almost unity. Other parameters, such as an index of plage activity, have spectra somewhat similar to sunspot spectra, but only a moderate degree of relationship to sunspot series. The data indicate that this lack of correspondence is due in large measure to "noise" in the plage data. An index of flare activity has an almost white "noise" spectrum, no maximum corresponding to the solar rotation period, and no relationship to sunspots.

247.   Weddell, J. B.,
PREDICTION OF PROBABILITY OF OCCURRENCE OF SOLAR FLARES, Astronautica Acta, Vol. 10, 1964, pp. 339-348.

A statistical method was developed which makes it possible to predict large solar eruptions 21 to 35 days in advance. Analysis of 984 large solar eruptions that occurred in the years from 1957 to 1960 showed that 75 percent of them occurred in places that had been noted during the preceding rotation of the sun. It was also found possible to predict flares from recent Ca-plages from properties of the magnetic field areas preceding the appearance of the plages.

248.   Westcott, P.,
THE 25- OR 26-MONTH PERIODIC TENDENCY IN SUNSPOTS, Journal of Atmospheric and Terrestrial Physics, Vol. 21, 1964, pp. 572-573.

It is assumed that certain power spectra analyses have confirmed the statistical significance of a roughly 25-month period in sunspot numbers. A method of running means is described by which only periods near 24 months will produce "beats" in the data. The period is then estimated to be 25.7 ± 0.3 months.

249. White, M. L.,
PROPOSED MAGNETO-CONVECTIVE MECHANISM FOR THE SOLAR CYCLES, Astronomical Journal, Vol. 70, 1965, p. 333.

In addition to the solar cycles, the mechanisms will help explain qualitatively other solar phenomena, including (1) M regions, (2) the shapes of the corona, (3) a complete history for the solar magnetic and sunspot cycles, (4) the formation of jet and loop prominences and flares, (5) magnetic monopoles in the photosphere, (6) the continual flow of prominence material downward from a chromospheric source, and (7) the morphology of the solar wind.

Note: This article is a resume of a paper presented at the 118th Meeting of the American Astronomical Society, held at the University of Kentucky, Lexington, Kentucky, on 14-17 March 1965.

250. Wolbach, J. G.,
ON THE UNEQUAL SPOTTEDNESS OF THE TWO SOLAR HEMISPHERES, Smithsonian Contributions to Astrophysics, Vol. 5, 1962, pp. 195-202.

On the basis of the Greenwich data (see Appendix A, item 31), the north-south asymmetry of the distribution of spot areas is examined for the time intervals of 1 year, one-half, and one entire eruption of solar activity. Particularly during the latter intervals, deviations from symmetrical distribution are far more frequent than would be expected from chance distribution. Definite periods could not be established for the alternation from north- to south-excess; however, the change from one hemisphere to the other seems to occur preferentially at the times of sunspot maxima or minima.

251. Wolbach, J. G.,
THE RELATIVE POSITIONS OF SUNSPOTS AND FLARES, Smithsonian Contributions to Astrophysics, Vol. 8, 1963, pp. 101-118.

This article describes a study of 11 flaring sunspots for which, on flare days, the relative positions of flares and sunspots were determined from data provided by the Climax and Mount Wilson

Observatories. All data for each spot group, including the magnetic polarities and field strengths, were projected to the center of the sun's disk and combined. The maps show that flaring tends to prefer regions containing both polarities rather than unipolar areas within a spot group. The favoured zone may be a spot cluster containing both polarities, as within $\beta\gamma$ and γ groups, or a region occupied by transient spots of both polarities, as in the following component of some βp and αp groups. Statistical analysis shows that flares preferred these regions more often than would be expected by chance. A supplementary investigation including additional sunspots revealed no correlation between frequency of flaring and internal spot activity such as the breakup or merging of small components.

A count of spot umbras covered by flares was made. About 10 percent of the flares show clear or possible coverage of some part of a spot umbra. The flares observed here covered the spots only partially or along the edges, a positional relation markedly different from that found by Ellison et al. (1961) for cosmic-ray flares, where the main body of the flare passed directly over the sunspot.

252. Wood, R. M. and Wood, K. D.,
SOLAR MOTION AND SUNSPOT COMPARISON, Nature, London, Vol. 208, 1965, pp. 129-131.

The velocity, acceleration, and variations of the acceleration of the motion of the sun were studied in relation to the center of mass of the solar system. The Wolf number and the length of the jerk vector were compared, and the influence of the motion of the sun on excitation of solar activity discussed.

253. Xanthakis, J.,
THE EXPRESSION FOR THE SOLAR ACTIVITY AS A FUNCTION OF RISE TIME, Annales d'Astrophysique, Vol. 22, 1959, pp. 855-876 (In French).

The maximum of the solar activity is established analytically as a function of the time of rise. The latter is expressed in solar synodic rotations or in months. It is shown that the maxima of the solar activity as well as their mean values per cycle obey a parabolic law. In certain cases the deviations from this law seem to be periodic functions of a long period. The mean daily areas of sunspots are studied in a second part for each year from 1879 to 1953,

as are the Wolf numbers from 1755 to 1953. In this case the analytical representation of the curves of the solar activity is given as a function of the time of rise expressed in years. Further, the following are examined: (a) The distribution of the secondary maxima and minima of the solar activity as a function of the time of rise. (b) The ratio $N/(N+S)$, where N and S represent the total areas of the spots for each cycle in the northern and the southern part of the solar equator respectively. (c) The asymmetry N/S of the two hemispheres, which can also be expressed as a function of the time of rise.

254.   Xanthakis, J.,
THE SUNSPOT AREAS AND THE RELATIVE SUNSPOT NUMBERS, Geofisica Pura e Applicata, Vol. 46, 1960, pp. 11-22 (In Italian).

The average values of the sunspot areas increase more rapidly from the minimum toward the maximum of solar activity than the corresponding Wolf numbers do; they diminish faster than the Wolf numbers from the maximum toward the minimum of solar activity. Hence the relation between the spot area and the Wolf numbers can not be represented by an unique law. Two formulas are proposed, one of which applies to the years before the maximum, while the other is valid for the years following the maximum.

255.   Xanthakis, J.,
THE REMARKABLY HIGH MAXIMA OF SOLAR ACTIVITY, Acad. Sci., Comptes Rendus, Vol. 253, 1961, pp. 1311-1312 (In French).

Based on calculations of a maximum Wolf sunspot number using an empirical method described previously (see item 253), it is shown that the differences (observed minus computed maximum values) are much greater than the Standard Deviation for cycles No. 9 (1843 to 1955), and 19 (1956). The form of the correction required to bring the results for these cycles within the scope of the method mentioned above is evaluated. A table gives the observed and calculated values of Rm, [Rm], Am, and [Am], for cycles No. 7 to 19.

256.   Xanthakis, J.,
ANALYTICAL RELATIONS OF THE NUMBERS OF SUNSPOT GROUPS AND OF RELATIVE NUMBERS, Annales d'Astrophysique, Vol. 25, 1962, pp. 342-356 (In French).

The annual averages of the relative numbers, of the spot and faculae-area sums, and of the number of new formations of sunspot groups per rotation period, can all very precisely be represented as functions of the time, with the rise time appearing as one of the parameters. For predictions based on this presentation, the probable rise time would have to be known with an accuracy of about 1/10 of a year.

257. Xanthakis, J. and Banos, G.,
THE SUNSPOT AREAS AND THE WOLF NUMBERS. A STUDY OF THE ANALYTICAL RELATIONS GIVEN BY J. XANTHAKIS AND J. MERGENTALER, Societa Astronomica Italiana, Memorie, Vol. 33, 1962, pp. 291-304.

New analytical relations between sunspot areas A and the corresponding Wolf numbers R have recently been given by Xanthakis [Praktika of the Athens Academy (Greece), Vol. 35, No. 352, 1960] and Mergentaler [Acta Astronomica (Poland), Vol. 9, No. 3, 1959]. In the first part, a comparative study of these relations is given. In the second part, an attempt is made to explain the large differences arising in some years between the ratio q = A/R resulting from observational data and the relations given by Xanthakis. Some irregularities in the ratio q can be explained if the types of the spot groups are taken into account. The ratio U/R, where U denotes the mean daily area of the umbra for each year, increases from the minimum to the maximum and decreases from the maximum to the minimum.

258. Xanthakis, J.,
A STUDY OF THE SUNSPOT MAGNETIC FIELD STRENGTHS, Societa Astronomica Italiana, Memorie, Vol. 36, 1965, pp. 25-40.

For each hemisphere a parameter ΣH is defined as the sum of the maximal values of the fields observed in each spot group during one year; these parameters are formed for the years from 1917 to 1958. Statistical analysis of these parameters indicates that their variation can be expressed as function of the time of the ascending branch of the cycles.

259. Xanthakis, J.,
THE RELATIVE SUNSPOT NUMBERS AND THE TIME OF RISE, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 17, 1966, pp. 215-233.

This study of the variation of the relative sunspot numbers is based on values for the period 1747 to 1963, especially the years 1823 to 1963 (cycles 7 to 19). It is shown that T_R plays a very important part in the variation of the relative number of spots during the rise time.

260. Xanthakis, J.,
PROBABLE VALUE OF THE TIME OF RISE FOR THE SUNSPOT CYCLE NO. 20, Nature, London, Vol. 210, 1966, pp. 1242-1243.

The variations of T_R (time interval between the minimum of solar activity and the following maximum) from one cycle to the next were calculated, using Waldmeier's data for 1610 to 1960. It is shown that T_R varies with the polarity of the magnetic fields of the sunspots in the cycles. The maximum of Cycle No. 20 should not appear before between 1968.2 and 1968.7.

261. Yilmaz, F.,
THE VARIATION OF THE AREAS OF FACULAE IN SOLAR ACTIVITY CENTERS, Istanbul University, Fen Fak. Mec., Seri C, Vol. 29, 1964, pp. 63-71 (In German).

The relations between facular and magnetic activity associated with the centers of active sunspot groups were studied, using as basis observational data obtained at the Fraunhofer Institut in the years 1957 and 1958.

262. Zabža, M.,
STATISTICAL INVESTIGATION OF SOLAR ACTIVITY, Acta Astronomica, Vol. 12, 1962, pp. 210-219.

The relations among the following five indices of solar activity were reviewed:

1) Sunspots.
2) Solar radio emission at $\lambda = 10.7$ cm.
3) Chromosphere eruptions.
4) Prominences.
5) The monochromatic corona emission at $\lambda = 6374$ Å.

The correlation coefficients of 10 possible combinations were calculated; all of them were > 0.67. The highest coefficient, 0.95, was obtained for the relation between radio emission and spot area.

263.   Zwaan, C.,
        CURVES OF GROWTH FOR A LARGE SUNSPOT, <u>Astronomical</u>
        <u>Institutes of the Netherlands, Bulletin</u>, Vol. 14, 1959, pp. 288-298.

From observations of the sunspot spectrum (λ 5110-5470 A) growth curves were derived for Ti I and Fe I, in which the linear segment is occupied also. An excitation temperature of $3900° \pm 200°$ was found. The "shoulder" of the growth curve lies 0.16 higher in the spot than in the photosphere. It is shown that this cannot be accounted for by magnetic amplification. Systematic errors (overlapping of weak lines) or increased turbulence (≈ 1.2 km/sec) may be the causes. Log $N_0 H$ for Ti I becomes by a factor of 1.02 larger

than in the photosphere, possible because of slightly less damping.

See also:

Section II, items 2, 3, 9, 11, 18, 19, 20, 22, 28, 30, 31, 32, 34, 35, 36, 41, 42, 43, 53, 54, 55, 57, 59, 60, 61, 75, 78, 80, 81, 82, 83, 84, 85, 86, 90, 91, 95, 96, 99, 102, 103, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 118, 119, 120, 124, 126, 127, 128, 129, 130, 135, 137, 139, 140, 141, 142, 143, 144, 145.

Section III, items 2, 3, 4, 5, 8, 9, 13, 14, 17, 20, 22, 23, 24, 25, 26, 27, 28, 32, 36, 37, 40, 42, 43, 46, 47, 49, 50, 51, 52, 53, 54, 55, 57, 60, 61, 62, 66, 67, 68, 69.

Section IV, items 2, 3, 4, 5, 6, 7, 9, 10, 12, 17, 19, 20, 21, 22, 26, 27, 29, 30, 31, 32.

Section II. IONOSPHERE EFFECTS

1.   Accardo, C. A., Smith, L. G., and Weeks, L. H.,
ROCKET MEASUREMENTS IN THE IONOSPHERE DURING THE
ECLIPSE OF JULY 20, 1963, II. E REGION, American Geophysical
Union, Transactions, Vol. 45, 1964, p. 48.

      Study of the absorption profiles of solar x-rays indicates an
ionization peak at 105 km altitude. Electron density and temperature
were investigated.

      Note: For measurements in the D region see item 136.

2.   Appleton, E.,
IONOSPHERIC CONSEQUENCES OF THE EARTH'S ORBITAL
ECCENTRICITY, Nature, London, Vol. 197, 1963, pp. 1239-1240.

      Because of the eccentricity of the Earth's orbit, the Earth
receives at the beginning of January 6.5 percent more electromagnetic
radiation than at the beginning of July. It is shown that the peak
values of the electron density in the E-layer of the ionosphere have
an annual trend comparable with that of the solar radiation (cf. items
26 and 90).

3.   Appleton, E.,
SUNSPOT-CYCLE CONTROL OF IONOSPHERIC AND GEOMAGNETIC
VARIATIONS, Journal of Atmospheric and Terrestrial Physics,
Vol. 26, 1964, pp. 633-640.

      The seasonal and sunspot-cycle variations of the E-layer
ionization and the intensity of the S_q overhead current have been
compared. Expressing the E-layer ionization in terms of its critical
penetration frequency, fE, it is found that

$$(fE)^2 = 10 \cdot 2 \sqrt{\cos \chi} \, (1 + 0 \cdot 0039 \, R),$$

where fE is measured in Mc/s, χ is the sun's zenith distance and
R is the Zürich sunspot number. A corresponding investigation of
the geomagnetic component Y of the S_q system leads to the relation

$$Y = 60 \cos \chi \, (1 + 0 \cdot 0039 \, R).$$

The fact that the E-layer is the only stratum in the ionosphere whose sunspot-cycle variation is identical with the corresponding variation in S_q leads to the conclusion that the S_q overhead currents actually flow at the E-layer level.

4.   Artem'yeva, G. M., Benediktov, Ye. A., and Getmantsev, G. G., THE RELATIONSHIP BETWEEN SPORADIC SOLAR RADIO EMISSION AND THE STATE OF THE IONOSPHERE, Izvestiya Vysshikh Uchebynkh Zavedenii, Radiofizika, Vol. 4, 1961, pp. 831- (In Russian).

Ionospheric phenomena associated with sporadic solar radio emission are divided into three groups. The first group includes those that have an onset almost simultaneously with the development of a radio emission burst. These phenomena are caused by an increase of solar ultraviolet and X-radiation at the time of chromospheric flares. Ionospheric disturbances in the second group occur 2 to 3 days after a radio emission burst. They are caused by solar corpuscular streams moving from the sun to the earth at velocities of $\sim 10^3$ km sec^{-1}. Phenomena in the third group include long-period changes of ionospheric parameters that correlate well with changes in the mean level of solar radio emission. The article contains a review of the literature and experimental data obtained in 1959 at the NIRFI.

5.   Avignon, Y., Martres-Trope, M.-J., and Pick-Gutmannn, M., IDENTIFICATION OF A CLASS OF SOLAR FLARES RESPONSIBLE FOR POLAR IONOSPHERIC ABSORPTIONS, Academie des Sciences, Comptes Rendus, Vol. 256, 1963, pp. 2112-2114 (In French).

A high degree of correlation is shown to exist between polar ionospheric absorptions, class IV radio-noise bursts, and duplex filamental flares originating over bipolar spot-groups in which the component umbrae are in close juxtaposition. Detailed characteristics of this new group of flares (designated Configuration A) are described, and a tabulated summary of 15 recent solar-cum-ionospheric events is included.

6.   Baker, D. M., AN ATLAS OF SOLAR FLARE EFFECTS IN THE IONOSPHERE OBSERVED WITH A HIGH-FREQUENCY DOPPLER TECHNIQUE, SEPTEMBER 1960-DECEMBER 1962, National Bureau of Standards, Technical Note No. 326, 1965.

Results are given of a study of records of sudden frequency variations (SFD), which originate primarily in the E- and F-layers. The types of records are described, and the occurrences are given in form of an atlas.

7. Baker, D. M., Davies, K., and Grimes, L.,
    OBSERVATIONS OF SUDDEN IONOSPHERIC FREQUENCY DEVIATIONS
    AT WIDELY SEPARATED PLACES, Nature, London, Vol. 210,
    1966, pp. 253-255.

    Investigation of four cases of sudden deviation showed that they can be ascribed to fluctuations of the ionizing solar radiation at the instant of a flare, rather than to a local perturbation of the ionosphere.

8. Baker, D. M. and Davies, K.,
    SOLAR FLARE EFFECTS AND THE RELAXATION TIME OF THE
    IONOSPHERE, Journal of Geophysical Research, Vol. 71, 1966,
    pp. 2840-2842.

    It is shown that during the day the relaxation time of the E- and F_1-region of the ionosphere is probably less than one minute.

9. Barclay, L. W.,
    VARIATIONS IN THE RELATION BETWEEN SUNSPOT NUMBER
    AND I_{F2}, Journal of Atmospheric and Terrestrial Physics, Vol. 24,
    1962, pp. 547-549.

    Naismith et al. (1961) have shown that the E-region character figure (Ch_E), corresponding to a given value of the relative sunspot number (R), progressively decreased over the five half-sunspot cycles from 1933 to 1947. Existence of a similar effect in higher parts of the ionosphere is considered.

10. Benediktov, Ye. A., Rapoport, V. O., and Eydman, V. Ya.
    RADIATION OF PLASMA WAVES IN THE IONOSPHERE,
    Geomagnetism and Aeronomy, Vol. 2, 1962, pp. 591-593.

    Incoherent radiation of plasma waves by corpuscular streams in the earth's ionosphere is examined. The intensity of radiation at 5 kc/s and 0.5 Mc/s is estimated.

11.   Ben'kova, N. P.,
            IONOSPHERIC INVESTIGATIONS IN THE USSR, Geomagnetism and
            Aeronomy, Vol. 1, 1961, pp. 2-17.

            A review of research carried out in the years 1957 to 1959 is
            presented.

            The principal aspects of this work were:

                I.   Regular observations in the network of ionospheric stations;
                II.   Investigations of the ionosphere using artificial satellites;
                III. Investigations of the quiet ionosphere;
                IV.   Ionospheric distrubances and the ionosphere in the high
                      latitudes;
                V.   Winds and tidal motions in the ionosphere;
                VI.   Ionospheric propagation of radio waves;
                VII. Ionospheric predictions;
                VIII. Development of new research methods and the building of
                      apparatus;
                IX.   Meteor radio investigation of the ionosphere.

            Note: This review is part of a report presented by the Radio
            Council AN SSSR at the XIII General Assembly of the International
            Scientific Radio Union (URSI) (London, 1960).

12.   Ben'kova, N. P., Bonchovskaya, Yu. S., and Shashum'kina, V. M.,
            THE IONOSPHERIC DISTURBANCES OF 10-18 JULY 1959, FROM
            OBSERVATIONS OF SOVIET IONOSPHERIC STATIONS,
            Geomagnetism and Aeronomy, Vol. 1, 1961, pp. 329-333.

            The chromospheric flares of 11, 14 and 16 July caused ionospheric
            absorption in high latitudes due to the radiation of high-energy
            particles. The flares of 14 and 16 July were accompanied also by
            increased absorption in the middle latitudes from ordinary corpuscular
            radiation. The data obtained by Soviet ionospheric stations are given
            here.

13.   Ben'kova, N. P. and Fligel', M. D.,
            IONOSPHERIC DISTURBANCES OF NOVEMBER 10-17, 1960,
            Geomagnetism and Aeronomy, Vol. 1, 1961, pp. 731-734.

            Six flares, ranging in importance from 2 to 3+ , were observed;
            the sudden ionospheric disturbances accompanying several of them

indicate intense radiation by the flares in the x-ray part of the spectrum. The emitted corpuscular streams traveled at speeds of about 1200 km/sec, judging from the retardation of the magnetic storms during that period.

14.   Beynon, W. J. G. and Brown, G. M.,
IONOSPHERIC INDICES OF SOLAR ACTIVITY, Journal of Atmospheric and Terrestrial Physics, Vol. 11, 1957, pp. 128-131.

In the course of some recent studies of small perturbations in the E-layer, a high degree of agreement was often found between measurements of fE at different ionospheric stations, and the purpose of this note is to again call attention to the great value of a "character figure" of the simple type originally introduced by Appleton and Naismith, and derived from accurate measurements of fE at one or two stations. At certain times, there is an almost one-to-one correspondence between the daily variations of fE and sunspot number R, and a study of the variations in the monthly mean character figure shows that these follow the sunspot number very closely, and that it is probably a very sensitive index of the ionizing radiation.

15.   Bourdeau, R. E., Aikin, A. C., and Donley, J. L.,
LOWER IONOSPHERE AT SOLAR MINIMUM, Journal of Geophysical Research, Vol. 71, 1966, pp. 727-740.

The problem of the formation of the E- and D-layers of the ionosphere is investigated with the aid of simultaneous measurements of solar x-rays by a satellite and of the penetration of Lyman α into these layers by two Apache rockets; the latter measurements were compared with data obtained in the laboratory.

16.   Bukin, G. V. and Fligel', M. D.,
THE WINTER ANOMALY IN THE E LAYER OF THE IONOSPHERE, Geomagnetism and Aeronomy, Vol. 2, 1962, pp. 914-916.

The data for many stations have been used to analyze the winter anomaly in the E layer, which consists of higher values for the critical frequency in winter than in summer, for an identical cosine of the solar zenith angle. The winter anomaly at Moscow and Yuzhno-Sakhalinsk is discussed for years of maximum and minimum solar activity. The value of the winter anomaly has been used to compute the effective recombination coefficient α and the ion formation rate I.

17. Cernuschi, F. and Codina, S.,
   COLLISION BETWEEN IONS FROM THE SUN AND NEUTRAL
   ATMOSPHERIC PARTICLES, Astronomical Journal, Vol. 69,
   1964, pp. 535-536.

   The energy of particles stopped by collision is given off as
   radiation the wavelength of which is largely in the portion of the
   spectrum explored by radio astronomy, and may affect observations
   made at radio-observatories especially during times of great solar
   activity.

   Note: This article is an abstract of a paper presented at the 116th
   Meeting of the American Astronomical Society, held 24-27 June
   1964 at Arizona State College, Flagstaff, Arizona.

18. Chaman, L.,
   THE DEVELOPMENT OF A FORMULA FOR THE SEASONAL AND
   SECULAR CHARACTERISTICS OF F_2 LAYER CRITICAL FREQUENCY,
   Telecommunication Journal, Vol. 33, 1966, pp. 257-262.

   It is shown that F_2-layer critical frequency $(\Sigma f_0 F_2)$ at any place
   on the earth, and at any epoch of the solar cycle is comprised
   principally of two components. An equation is given, which describes
   to a close approximation the secular trend of $(\Sigma f_0 F_2)$.

19. Chavdarov, S. S., Chernysheva, S. P., and Shatkin, Kh. Z.,
   STABILITY OF REFLECTIONS FROM THE SPORADIC E-LAYER
   AND SOLAR ACTIVITY, Geomagnetism and Aeronomy, Vol. 6,
   1966, pp. 109-111.

   From f-graphs and monthly $f_0 E_S$ tables the probabilities of the
   appearance of E_S with various durations of continuous reflections
   were computed for each hour of the day. These data and the
   relationship

   $$(pE_S)_{state} = (pE_S) \exp(\tau / \vartheta)$$

   were used to compute the stability coefficients for each hour from
   1960 to 1965. The variations of pE_S, $(pE)_{\tau' > \tau_0}$, τ, and ϑ were
   analyzed in relation to the 11-year cycle. Solar activity was
   characterized by mean monthly and annual Wolf numbers that were

compared with the maximum values of the parameters mentioned above. It was found that the parameters $(pE_S)_{\tau' > \tau_0}$ and ϑ give a good description of the sporadic layer, and that there are clear correlations with the Wolf number.

20.   Chavdarov, S. S. and Chernysheva, S. P.,
        VARIATION OF THE E_S PARAMETERS IN THE SOLAR CYCLE,
        Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 613-614.

        Analysis of data obtained at Rostov-on-the-Don and other stations suggests that the relationships between $(pE_S)_{\tau \geq \tau_0}$ variations and the solar activity index, W, are not some local phenomenon. Further it was found that the values of general probability cannot yield a definite solar activity dependence which suggests that reflections of small and of prolonged duration are produced by inhomogeneities of different scales and natures.

21.   Chilton, C. J., Conner, J. P., and Steele, F. K.,
        A COMPARISON BETWEEN SOLAR X-RAY EMISSION AND VLF
        SUDDEN PHASE ANOMALIES, IEEE Proceedings, Vol. 53, 1965,
        pp. 2018-2026.

        Very low frequency (VLF) sudden phase anomaly (SPA) data obtained during 1963 are presented for comparison with solar X-ray emission measurements made by VELA satellites during the same period. From the SPA data an estimate is made, for each of three flares, of the effective wavelength of monochromatic X-rays that would have produced the same VLF phase effects as the actual X-ray emission. In addition, using the X-ray intensity (flux density) measurements of the satellite data and the wavelength functions obtained from the SPA data, estimates are made of the effective recombination coefficients. Furthermore, it is indicated that the VLF phase anomaly produced by X-rays from a high altitude nuclear explosion can possibly be distinguished from that produced by X-rays from a solar flare.

22.   Chun-Ming, Huang,
        SOME REMARKS ON THE STATISTICAL STUDIES OF SPORADIC-E,
        Journal of Atmospheric and Terrestrial Physics, Vol. 28, 1966,
        pp. 87-96.

It was found that the logarithm of the probability of occurrence of $f_0E_S < f$ varies linearly with f up to a certain frequency. The seasonal variation of the occurrence of E_S, established from a 27-day running average, indicates that the phase of season differs markedly from year to year. An effect of solar tides on f_0E_S and $h'E_S$ exists.

23.   Dalgarno, A.,
       CHARGED PARTICLES IN THE UPPER ATMOSPHERE,
       Annales de Géophysique, Vol. 17, 1961, pp. 16-34.

       A comprehensive review is presented of collision processes
       involving charged particles in the upper atmosphere.

24.   Danilkin, N. P.,
       VERTICAL MOVEMENTS IN THE IONOSPHERE OVER
       SIMFEROPOL' DURING THE SOLAR ECLIPSE OF 1961, Geomagnetism
       and Aeronomy, Vol. 3, 1963, pp. 388-392.

       This article presents the results of computations of $N(h)$
       profiles of the ionosphere over Simferopol' during the solar eclipse
       of 1961. An estimate has been made of the value and character of
       vertical movements at different heights in the F region. It is
       postulated that the observed changes of electron density at fixed
       heights can be attributed to vertical transport of electrons in the F
       region.

25.   Danilov, A. D. and Ivanov-Kholodnyy, G. S.,
       EXPERIMENTAL DATA ON THE MAGNITUDE OF ENERGY
       SOURCES IN THE IONOSPHERE, Geomagnetism and Aeronomy,
       Vol. 3, 1963, pp. 688-693.

       The most reliable data on the magnitude of energy sources in
       the ionosphere now indicate a value of from 3 to 10 $erg/cm^2 \cdot sec$.
       The authors discuss a number of problems concerning the energy
       source and balance in the earth's upper atmosphere.

26.   Das Gupta, M. K. and Basu, D.,
       EFFECT OF THE EARTH'S ORBITAL ECCENTRICITY ON
       INCIDENT SOLAR FLUX AT 10.7 cm, Journal of Atmospheric and
       Terrestrial Physics, Vol. 26, 1964, pp. 135-137.

For equal solar activity the intensity of the incident solar radiation is by 6.5 percent smaller during June–July than during December–January. A corresponding deficit of 7.5 percent in the maximum electron density of the E-layer was found (cf. Appleton, item 2). The monthly average values of the intensity of the solar 10.7 cm radiation were found to be likewise low (7.6 percent).

27.   Davies, K. and Donnelly, R. F.,
       AN IONOSPHERIC PHENOMENON ASSOCIATED WITH EXPLOSIVE
       SOLAR FLARES, Journal of Geophysical Research, Vol. 71, 1966,
       pp. 2843-2845.

       Evidence is presented that there is a direct relation between the
       occurrence of SFDs and the explosive phases of visible H_α-flares.

28.   Dolgova, Ye. I.,
       IONOSPHERIC-MAGNETIC DISTURBANCES IN YEARS OF
       MAXIMUM SOLAR ACTIVITY, Geomagnetism and Aeronomy,
       Vol. 5, 1965, pp. 340-345.

       Charts of the distribution of L disturbances are constructed, and
       the presence of a maximum in intensity and in the latitude of
       propagation of L disturbances at definite hours of universal time is
       established. $D_{st}(\Delta f_0 F_2)$ are determined for several high-latitude

       stations. Differences are found in the diurnal variation of $(\Delta f_0 F_2)$
       and absorption for types SC and G storms.

29.   Eryushev, N. N.,
       ANALYSIS OF IONOSPHERIC EFFECTS OF RECORDED SOLAR
       FLARES ON LONG WAVES AND f_{min}, Izvestiya Krymsk. Astrofiz.

       Obs., Vol. 33, 1965, pp. 160-163 (In Russian).

       The author established a link between sudden-commencement
       perturbations of the ionosphere, their impact on atmospherics and
       f_{min}, or on both, and the spectral composition of the x-rays

       emitted by the flare.

30.   French, A. G.,
       SEASONAL VARIATION OF SOME F-REGION PARAMETERS AT
       SUNSPOT MINIMUM, Journal of Atmospheric and Terrestrial
       Physics, Vol. 28, 1966, pp. 9-16.

Eleven months' data, consisting of midday values of the electron production, q_{45}, and the 'linear' loss coefficient, β_{45}, at $\chi = 45°$ for Godley Head and Campbell Island are presented. The latitudinal and seasonal variations in both q_{45} and β_{45} are discussed; the latter in terms of the effects of travelling ionospheric disturbances. Unlike sun-spot maximum data which show a broad winter minimum in β_{45}, the sun-spot minimum data exhibit considerable fine-scale structure, and a late summer sudden decrease in β_{45} is included.

31. Ganesh, K. S.,
SOLAR CYCLE AND SEASONAL VARIATIONS IN THE EQUATORIAL IONOSPHERIC F-REGION, Journal of Atmospheric and Terrestrial Physics, Vol. 27, 1965, pp. 645-655.

For a study of the effect of solar activity on different levels of the equatorial ionosphere, the representative (Nh) profiles were obtained from Kodaikanal ionograms covering a period of about one solar cycle. Anomalies characteristic of the seasons and of the Far East were analyzed. From the profiles the total number of electrons in the F-layer was calculated for a study of the diurnal asymmetry.

32. Gerson, N. C.,
THE ARCTIC IONOSPHERE AND SOLAR ACTIVITY, Annales de Géophysique, Vol. 16, 1960, pp. 253-261.

Ionospheric conditions at several arctic stations have been correlated with solar activity using monthly median critical frequencies for the E, F_1, and F_2 layers, and the 13-month mean Zürich sunspot numbers. The stations examined were: Baker Lake, Churchill, College, Narsarssuak, Oslo, and Point Barrow. Local noon data for each layer were utilized and, in addition, local midnight values for the F_2 layer.

33. Glenn, J.,
CORRELATION OF VLF AND VELA SATELLITE X-RAY DETECTORS WITH SOLAR X-RAY EMISSION, American Geophysical Union, Transactions, Vol. 45, 1965, pp. 623-624.

Divers ionospheric phenomena were compared with the emission of x-rays by the sun.

34. Godoli, G. and Tagliaferri, G. L.,
     ON THE VARIATIONS IN THE RELATIONS OF SOLAR INDICES TO
     E- AND F- REGION CHARACTER FIGURES, Journal of Atmospheric
     and Terrestrial Physics, Vol. 28, 1966, pp. 933-944.

     The long-term variations in these relations can be interpreted
     simply by considering the behavior of the solar indices without
     assuming variations in the solar radiation.

35. Goncharova, Ye. Ye. and Kuleshova, V. P.,
     STATISTICAL DISTRIBUTION OF $\Delta f_0 F_2$, Geomagnetism and Aeronomy,
     Vol. 6, 1966, pp. 107-109.

     For the short-range forecasting service of ionospheric
     disturbance $\Delta f_0 F_2$ distribution curves were constructed; $f_0 F_2$
     data for 1958 and 1963 (years of high and low solar activity,
     respectively) from stations in middle latitudes, in the auroral zone,
     and on the polar cap were used. An analysis of the statistical
     distribution of $\Delta f_0 F_2$ according to data from the stations is given.

36. Gorbushina, G. N. and Zhulina, Ye. M.,
     ZONE OF ANOMALOUS ABSORPTION DURING VARIOUS PHASES OF
     THE SOLAR ACTIVITY CYCLE, Geomagnetism and Aeronomy,
     Vol. 6, 1966, pp. 453-455.

     In this paper a study is presented of the geographic position of
     the zone of anomalous absorption during 1962. Comparison with the
     maximum frequency of anomalous absorption during 1958 showed a
     northward shift by about two degrees and an increase from 20 to 35
     percent which may be partly the result of the low critical frequencies,
     frequently occurring in years close to the solar activity minimum,
     of the F_2-layer ($f_0 F_2$).

37. Grishkevich, L. V.,
     RESULTS OF INVESTIGATIONS OF IONOSPHERIC DRIFTS OVER
     GOR'KIY DURING 1957-1959, Izvestiya Vysshikh Uchebnykh
     Zavedeniy, Radiofizika, No. 4, 1961, pp. 608- (In Russian).

     This article gives the principal results of observations of
     ionization drifts in the E and F regions of the ionosphere recorded
     during the IGY-IGC period at Gor'kiy. Data on movements in the F
     region are compared with the results of investigations made at
     Moscow (IZMIR) and Cambridge.

38. Hakura, Y.,
     TIME VARIATIONS IN THE SOLAR X-RAYS PRODUCING SID'S,
     Report of Ionosphere and Space Research in Japan, Vol. 20, 1966,
     pp. 30-32.

     The author discusses variations with time of the intensity of the
     ionizing radiation; the variations are deduced from the fading of
     short waves observed at the observatory at Hiraiso. The relation
     between the fading and the very hot condensations in the solar corona
     is examined.

39. Hakura, Y. and Nagai, M.,
     POLYPHASE ASPECTS OF THE EARTH'S UPPER ATMOSPHERE
     DISTURBANCES CAUSED BY A SOLAR FLARE, Report of Ionosphere
     and Space Research in Japan, Vol. 20, 1966, pp. 66-68.

     Geomagnetic, auroral, and ionospheric occurrences following
     the solar flare of 9 February 1958 are described. The flare was
     accompanied by radio bursts of type IV.

40. Hall, R. B.,
     THE FORMATION OF THE SPORADIC-E LAYER, Journal of
     Atmospheric and Terrestrial Physics, Vol. 26, 1964, pp. 1143-1146.

     It is assumed that sporadic-E is caused by the vertical movement
     of ionisation to form a layer of enhanced ionisation, the limiting width
     of such a layer being determined by the effects of diffusion. Thus
     since the diffusion constant varies markedly with geomagnetic latitude
     it is predicted that layer formation will be more likely near to the
     geomagnetic equator and that the layer thickness will vary as sin I,
     where I is the angle of magnetic dip.

41. Hansen, R. and Kleczek, J.,
     COINCIDENCE OF SUDDEN IONOSPHERIC DISTURBANCES WITH
     THE EXPLOSIVE PHASE OF SOLAR FLARES, Nature, London,
     Vol. 195, 1962, pp. 1280-1281.

     Sudden ionospheric disturbances occurred almost simultaneously
     with the ejection of material in nine cases of 11 flares accompanied
     by ejection of material. The explosive phases of the flares of
     2 August 1958 and 20 November 1960 at the limb of the sun are
     described.

42. Harnischmacher, E.,
     SOLAR INFLUENCE ON THE NORMAL E LAYER OF THE
     IONOSPHERE, Acad. Sci., Comptes Rendus, Vol. 230, 1950,
     pp. 1301-1302 (In French).

     Long series of critical frequency data [f_c] for the normal E
     layer for a number of stations have been examined in relation to
     the equation $f_c = K \cos^n \chi$ [χ = solar zenith angle]. Best values of
     K and n are determined and expressions showing the dependence of
     these constants on latitude and sunspot number are given.

43. Harris, I. and Priester, W.,
     THEORETICAL MODELS FOR THE SOLAR-CYCLE VARIATION
     OF THE UPPER ATMOSPHERE, Journal of Geophysical Research,
     Vol. 67, 1962, pp. 4585-4591.

     This article presents a continuation and tabulated evaluation of
     formulas derived in an earlier study (NASA Report X-640-62-70,
     Goddard Space Flight Center, Greenbelt, Md.) of the temporal
     variation of the atmospheric structure in the height range from
     120 to 2050km. As causes of the changes the variation of solar
     activity in the UV and the quantity of the corpuscular stream are taken
     into consideration.

     Note: A theory of the diurnal density fluctuations of the atmosphere
     at these heights was presented by the authors in NASA Report
     X-640-62-69, Goddard Space Flight Center, Md. This report
     includes further a tabulation of the density parameters calculated
     according to the theory.

44. Harrison, V. A. W.,
     IONOSPHERIC EFFECTS ASSOCIATED WITH THE SOLAR FLARE
     OF JULY 10, 1959, Nature, London, Vol. 186, 1960, pp. 228-229.

     An investigation was made during a major flare (importance:
     3+) of the critical frequency of the F_2-layer (f_0F_2), the lowest
     frequency giving echos from the E- or F-layer (f_{min}), and the
     electron density in the D-layer in relation to the average values on
     other days (B/B_0). At the beginning of the flare f_{min} and B/B_0
     increased greatly, returning to their normal values after a few hours
     in agreement with the duration of the flare. An unusual impulse was

observed shortly after the period of greatest absorption; it is ascribed to the flare, since no comparable impulse had occurred during the entire month.

45. Huang, Y.-N.,
ON THE ASYMMETRICAL MAGNETIC AND IONOSPHERIC EFFECTS CAUSED BY THE LARGE SUNSPOTS WHICH APPEARED ON THE NORTHERN AND THE SOUTHERN HEMISPHERE OF THE SUN, Journal of Atmospheric and Terrestrial Physics, Vol. 26, 1964, pp. 607-613.

The results of this study, using the superposed-epoch method, show that the geomagnetic activity caused by large sunspots on the northern hemisphere is greater than that caused by those on the southern one. Application of the method to ionospheric effects shows that the noon f_0F_2 corresponding to the sunspots which appeared on the northern hemisphere is, contrary to the case of the geomagnetic activity, smaller than that corresponding to the sunspots which appeared on the southern hemisphere. Reasons for such an asymmetry were not well known; however, one of the possible reasons for the smaller value of f_0F_2 for the northern sunspots than that for the southern ones seems to be that the geomagnetic activity caused by the northern sunspots is larger than that caused by the southern ones.

46. Ivanov-Kholodnyy, G. S.,
INTENSITY OF SHORT-WAVE SOLAR RADIATION AND THE RATE OF IONIZATION AND RECOMBINATION PROCESSES IN THE IONOSPHERE, Geomagnetism and Aeronomy, Vol. 2, 1962, pp. 315-336.

This article reviews mainly problems associated with the interpretation of new data in the following fields of research

1. Energy and Spectrum of Ionizing Solar Radiation
2. Ion Composition of the Ionosphere
3. Corpuscular Streams in the Ionosphere

The data used in this research were obtained by rockets and artificial earth satellites.

47.   Ivanov-Kholodnyy, G. S.,
        IONIZATION OF THE UPPER ATMOSPHERE BY SOLAR SHORT-
        WAVE RADIATION, Geomagnetism and Aeronomy, Vol. 2, 1962,
        pp. 561-571.

        New data on the energy and spectrum of short-wave solar
        radiation have been taken into account in computing the absorption
        of radiation and the rate of ion formation at altitudes of 100 to 800 km
        in the atmosphere for different times of day. A peak of ion formation
        has been discovered at an altitude of ~ 120 km and the diurnal
        variation of n_e in the E, F_1 and F_2 regions of the ionosphere has
        been explained. The author also considers the effect of a daytime
        increase in the density of the upper atmosphere (asymmetric relative
        to midday), making it possible to explain a number of ionospheric
        effects. Conclusions have been drawn on the value of the effective
        recombination coefficient.

48.   Ivanov-Kholodnyy, G. S.,
        IONIZATION MECHANISM OF THE LOWER IONOSPHERE, I,
        Geomagnetism and Aeronomy, Vol. 5, 1965, pp. 544-556.

        Ionization at heights of 60-100 km is computed for various
        activity levels of the quiet sun and during solar flares. The following
        conclusions are reached on the basis of a comparison of the results
        of these computations with the results of n_e and α' measurements:
        1) cosmic rays produce stronger ionization than does solar
        radiation below ~ 75 km during minimum solar activity and below
        ~ 65 km during maximum activity; 2) solar X-radiation shorter than
        10-20 Å can explain ionization only below 85-90 km, while above,
        X-radiation of greater wavelength and ultraviolet radiation (~ 1000 Å)
        act simultaneously; 3) in the height interval 75-90 km electron
        concentration must vary by 0.5-1 order of magnitude during the solar
        cycle; 4) it is difficult to explain ionization in the region 70-85 km
        by the effect of solar Lyman-α emission; rocket and satellite data
        on solar flare X-radiation agree with ionospheric data for n_e and α'
        during ionospheric disturbances; and 6) a third, sporadic, ionization
        source must be assumed in the height interval 60-75 km.

49.   Ivanov-Kholodnyy, G. S.,
        ION FORMATION INTENSITY AT HEIGHTS OF 100-300 KM,
        Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 302-305.

New data on the spectrum of solar ionizing radiation, on effective absorption and ionization cross section, and on the composition of the upper atmosphere made it possible to refine considerably the earlier estimates of the rate of ion formation, q. Profiles of q(h) were obtained for low and high solar activity, taking into account zenith distances from 0 to 90 degrees. The values obtained are compared with the results of computations by other authors and with ionospheric data.

Note: This article is, in effect, Part II of the preceding item.

50.   Jacchia, L.,
INFLUENCE OF SOLAR ACTIVITY ON THE EARTH'S UPPER ATMOSPHERE, Planetary and Space Science, Vol. 12, 1964, pp. 355-378.

Irregularities in the motion of artificial satellites could be explained by density fluctuations in the upper atmosphere. There are several distinct types of density fluctuations, but all were found to be related to observable parameters connected with solar activity. The basic facts that seem to be established without much doubt are listed, and causes and effects are described.

51.   Jagath Kumar, V. R. and Ramachandra Rao, B.,
LATITUDE EFFECT ON THE VARIATION OF SPREAD-F OCCURRENCE WITH SUNSPOT NUMBER, Nature, London, Vol. 207, 1965, pp. 1083-1084.

A quantitative investigation of observations by a great number of stations in both hemispheres was made, and it was established that a systematic variation is a function of the latitude. The occurrence of spread-F increases simultaneously with the sunspot number between 12 degrees South and 18 degrees North; an inverse effect exists at latitudes farther South and North, respectively.

52.   Jagath Kumar, V. R. and Ramachandra Rao, B.,
LATITUDE VARIATION OF PEAK OCCURRENCE PROBABILITY OF SPREAD-F, Indian Journal of Pure and Applied Physics, Vol. 3, 1965, pp. 503-504.

During a year of a sunspot maximum the probability of spread-F attains its maximum before midnight in geomagnetic latitudes $< 20°$ and $> 65°$; between $20°$ and $65°$ this maximum occurs after midnight.

Near the spot minimum the crest observed before midnight appears in a narrower latitude interval.

53. Joachim, M.,
AN IONOSPHERIC HYSTERESIS EFFECT, Academie des Sciences, Comptes Rendus, Vol. 263, 1966, pp. B92-B94 (In French.

Separation of data from the part of a solar cycle in which the activity increases from the part in which it decreases has revealed an ionospheric hysteresis effect of the values of I_{F_2} as a function of R_{12} or of Φ. Formulas and graphs are given to facilitate numerical calculation at the time of prediction of the values of these indices.

54. Joachim, M.,
INDIRECT METHOD OF PREDICTING THE SOLAR INDEX Φ, Telecommunication Journal, Vol. 33, 1966, pp. 174-175.

Based on the actual values since 1947 of the solar flux Φ at 2800 Mc/sec, relations are established between Φ, $\Delta\Phi$ and I_{F_2}.

Note: Errata in the equation for Φ and in the designation of the abscissa of fig. 2 are corrected on p. 209.

55. Joachim, M.,
STUDY OF CORRELATION OF THE THREE BASIC INDICES OF IONOSPHERIC PROPAGATION: R_{12}, I_{F_2} and Φ, Nature, London, Vol. 210, 1966, pp. 289-290.

Tables are given of existing values of these three indices, and correlation curves have been plotted for prediction of I_{F_2} and Φ from R_{12}.

56. Johnson, C. Y.,
IONOSPHERIC COMPOSITION AND DENSITY FROM 90 TO 1200 KILOMETERS AT SOLAR MINIMUM, U. S. Naval Research Laboratory, Report of NRL Progress, PB 168 488, September 1965, pp. 11-14.

Relative ion composition measurement from two daytime positive ion mass spectrometer experiments, one at 90 to 240 and one at 400 to 1200 kilometers, have been normalized to a composite electron density distribution in the altitude range 90 to 1200 kilometers. The

result is a number density distribution of the positive ions and electrons in the daytime ionosphere during the 1963-1964 solar minimum. Distributions are shown for ions of hydrogen, helium, atomic and molecular nitrogen, atomic and molecular oxygen, and nitric oxide.

57. Kallmann-Bijl, H. K.,
VARIATIONS OF ATMOSPHERIC PROPERTIES WITH TIME AND SOLAR ACTIVITY, Journal of Atmospheric and Terrestrial Physics, Vol. 24, 1962, pp. 831-841.

The diurnal changes of the physical parameters of the atmosphere were computed for the levels 350km and 650km. Solar activity and these diurnal changes were compared. During strong solar activity the atmosphere is in daytime by a factor of 200 more dense than at night during low solar activity. The temperature difference between day and night may be as much as 700°. The calculated trend of the temperature at 650km is in satisfactory agreement with experimental data.

58. Kazachevskaya, T. V. and Ivanov-Kholodnyy, G. S.,
ROCKET DATA ON THE BEHAVIOR OF ELECTRON CONCENTRATION IN THE IONOSPHERE AT HEIGHTS OF 100-300 KM, I, Geomagnetism and Aeronomy, Vol. 5, 1965, pp. 794-805.

The results of rocket measurements of electron concentration in a quiet ionosphere are compared with solar and geomagnetic activity as a function of time of day, season, etc. An empirical model of the daytime ionosphere is constructed for winter and summer at high and low solar activity levels. The character of $n_e(h)$ profiles changes throughout the day. A power-law dependence of the n_e variation on atmospheric air mass is found for definite solar zenith angles; the rate of the n_e decrease at noon in winter is ~ 2 times higher than in summer for $z_\odot = 70-90°$. When the sun is in a low position a maximum forms at the horizon at heights of 110-130 km, and a "trough" appears in the $n_e(h)$ profile above it. An explanation is given for the characteristics found in the behavior of n_e.

59.   Kerblay, T. S.,
       SOME RESULTS FROM THE STATISTICS OF VARIOUS TYPES OF
       E_s-LAYER, Geomagnetism and Aeronomy, Vol. 2, 1962,
       pp. 411-418.

       The diurnal variations of the probability of occurrence of f_0E_s
       and f_bE_s values exceeding 3 Mc/s were obtained for each type of
       E_s (according to international classification) from data of 25
       ionospheric stations. Comparison of data for the Northern and
       Southern Hemispheres showed a slight nonseasonal asymmetry of the
       type c. Conclusions are drawn concerning the effectiveness of
       individual types of E_s during the propagation of short radio waves.

60.   Kerblay, T. S.,
       VARIATIONS OF MAXIMUM ELECTRON CONCENTRATION IN THE
       F_2-LAYER WITH SOLAR ACTIVITY, Geomagnetism and Aeronomy,
       Vol. 6, 1966, pp. 254-257.

       Computed estimates of the dependence of N_mF_2 on solar activity
       are compared with the results of ionospheric observations. The
       conclusion is reached that the presently known solar-cycle-variations
       in the temperature of the upper atmosphere can explain the form of
       the relationship $N_m(R)$ for a daytime, middle-latitude ionosphere.

61.   Kerblay, T. S. and Korochkina, A. A.,
       DEPENDENCE OF THE E_S LAYER ON SOLAR ACTIVITY,
       Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 443-446.

       The most pronounced variations with the cycle were found for the
       total number of cases with E_S, N, for f_0E_S, and for percent (or total
       number) of cutoff frequencies $P_{fE_S} > 5MHz$. An inverse correlation
       with solar activity was found for N at middle latitude stations, while
       a direct correlation was obtained for the other two characteristics.
       A straight pattern of these characteristics was found for the
       equatorial station at Huancayo. The patterns from the extreme
       northern and southern stations (Murmansk and Wilkes) are widely
       different.

       Apparently there was no regular redistribution of E_S by types
       with the cycle and succession of the prevailing type of E_S.

The influence of absorption on E_S characteristics is borne out by E_S statistics; the characteristics themselves must depend differently on solar activity.

62.   Khocholova, G. M.,
       ANOMALOUS ABSORPTION IN THE POLAR CAP, Geomagnetism
       and Aeronomy, Vol. 2, 1962, pp. 90-96.

       This article discusses periods of anomalous absorption in the
       polar cap recorded from June 1957 through July 1959. It is shown
       that some periods can be correlated with class 2 and 2+ chromospheric
       flares. Two types of anomalous absorption in the polar cap are
       defined — simultaneous and gradual. These differ in the time of
       commencement. The author points out the peculiarities in the
       development of the phenomenon in the different seasons for both
       hemispheres of the earth. An attempt is made to explain the absence
       of a correlation between anomalous absorption and geomagnetic
       activity in these periods.

63.   Khocholava, G. M.,
       ANOMALOUS ABSORPTION IN THE POLAR CAP RESULTING
       FROM LARGE CHROMOSPHERIC FLARES, Geomagnetism and
       Aeronomy, Vol. 3, 1963, pp. 735-740.

       This paper is devoted to the study of anomalous absorption in
       the polar cap. The most disturbed periods of anomalous absorption
       are investigated and two types of anomalous absorption and their
       duration and diurnal variation are examined.

64.   Khocholava, G. M.,
       ANOMALOUS ABSORPTION IN THE POLAR CAP, Geomagnetism and
       Aeronomy, Vol. 2, 1962, pp. 907-913.

       This article discusses several problems related to the study of
       anomalous absorption in the polar cap (additional ionization in the
       ionosphere, density of the stream of fast particles, dynamics of the
       region of anomalous absorption before and after the commencement of
       a SC geomagnetic storm). It is shown that the additional electron
       concentration is $10^4 - 10^5$ cm^{-3} and the density of the stream of fast
       particles is $10^{-8} - 10^{-10}$ cm^{-3}. Different types of relationships
       between anomalous absorption in the polar cap and a SC geomagnetic
       storm are pointed out. An explanation is given for the difference
       between the theoretically predicted and experimentally derived

displacement of the outer boundary of anomalous absorption at the time of the main phase of a storm.

65. Kim, J. S.,
ENHANCEMENT FACTOR AND TRUE ABSORPTION OF THE V.H.F.
COSMIC RADIO NOISE ASSOCIATED WITH SOLAR FLARES,
Nature, London, Vol. 212, pp. 1341-1342.

When the cosmic radio noise is stronger than normal, the absorption measured by comparison with the curve for a quiet day is very different from the true absorption. A method is given for taking into account the reenforcement of the noise by giving special consideration to measurements with multiple-frequency riometers; this applies particularly to bursts of type IV.

66. King, G. A. M. and Lawden, M. D.,
A LIMITED SURVEY OF THE F_1-REGION IN SUMMER AT SOLAR MINIMUM, Journal of Atmospheric and Terrestrial Physics, Vol. 28, 1966, pp. 871-877.

The ionograms obtained at Campbell Island during December 1963 and January 1964 were analyzed by the method of envelops to yield a measure for the rate of production and loss of electrons, and for the scale heights of the F_1-region. The ratio of the speeds of the oxygen atoms and molecules, which determines the rate of loss, varied suddenly during the period.

67. Kiseleva, M. V.,
RADIO COMMUNICATIONS CONDITIONS AT HIGH LATITUDES IN YEARS OF DECREASING SOLAR ACTIVITY, Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 672-676.

A study is made of radio communications conditions on zonal links under various degrees of ionospheric disturbance. It is shown that prolonged disruptions of radio communications are observed at the time of strong magnetic-ionospheric disturbances because of anomalous absorption, of the appearance of a sporadic E, and of the closeness of the operating frequency to the LUF.

68. Kotadia, K. M.,
SOLAR FLARE EFFECTS ON F_2-IONIZATION IN LOW LATITUDES,
Journal of Atmospheric and Terrestrial Physics, Vol. 28, 1966,
pp. 143-152.

Results are given of a study of the effects of solar flare radiation on the electron density of the F_2-layer to its maximum level and near the zone of the equatorial anomaly. The f_0F_2 increases especially when the solar flares occur during the day when the sun is at low altitude; this effect is particularly marked during the winter.

69.   Kovner, M. S. and Trakhtengerts, V. Yu.,
       THE INTERACTION BETWEEN WEAK CORPUSCULAR STREAMS
       AND THE UPPER ATMOSPHERE, Geomagnetism and Aeronomy,
       Vol. 2, 1962, pp. 871-876.

This article considers certain problems relating to the generation of ultra low frequency radiation in the earth's upper atmosphere by solar corpuscular streams. The hypothesis that electromagnetic waves are excited at frequencies close to $\omega_H \cos \alpha$ makes it possible to explain qualitatively a number of observed spectral characteristics. The determined values of the optical thickness and the amplification factor make it possible to estimate the velocities and concentrations of the streams necessary for exciting the ultra low frequency radiation.

70.   Kuleshova, V. P.,
       PLANETARY CHARACTERISTIC OF IONOSPHERIC DISTURBANCE,
       Geomagnetism and Aeronomy, Vol. 5, 1965, pp. 441-443.

A method is described, by means of which it is possible to judge the energy parameters of solar radiation from the point of view of their effects on the earth.

71.   Lazarev, V. I.,
       IONIZING RADIATION AND WARMING OF THE UPPER ATMOSPHERE,
       Geomagnetism and Aeronomy, Vol. 3, 1963, pp. 681-687.

Examination of photochemical processes in the upper atmosphere makes it possible to deduce the vertical temperature distribution in it. It is shown that about 40 percent of the ionizing radiation energy absorbed in the atmosphere is converted into heat. The daytime flux of ionizing radiation is estimated at 3-12 erg/cm^2 sec from data on the warming of the upper atmosphere.

The vertical temperature distribution in the night ionosphere is computed. It is shown that the warming of the upper atmosphere at night may be caused by electrons of an energy exceeding 100 ev, whose flux is ~ 0.4-1.6 erg/cm^2 sec. It is found that at night the temperature at a height of 200 km is $\sim 700°K$ and at 350 km, $\sim 1130°K$.

72.   Letfus, V. and Serafimov, K.,
        IONIZATION OF THE E LAYER AND SOLAR X-RAYS IN THE
        RANGE 44-60 Å, Geomagnetism and Aeronomy, Vol. 6, 1966,
        pp. 278-281.

        When computing the characteristic numbers of the E-layer one
        must eliminate the seasonal variation of aeronomic parameters and
        allow for temperature variations with height and time. For this
        purpose it is appropriate to construct a graph of the annual
        dependence of the characteristic numbers on the zenith angle of the
        sun. The characteristic numbers thus obtained in a year of the
        quiet sun (1964) at one station agree well with the intensity of solar
        X-rays in the range 44-60 Å.

73.   Levitskii, L. S.,
        ON THE CONNECTION BETWEEN INCREASED SOLAR RADIO
        EMISSION IN THE METER RANGE AND ABSORPTION IN THE
        POLAR CAP, Izvestiya Krymsk. Astrofiz. Obs., Vol. 32, 1964,
        pp. 84-87 (In Russian).

        The author found that 40 percent of increased rf-radiation in the
        meter-wave band (duration from about three hours to three days)
        are related to rf-pulses in the cm-band, and are directional. The
        meter-wave radiation originates frequently after bursts accompanied
        by absorption in the polar cap.

74.   Likhachev, A. I.,
        DEPENDENCE OF F_2-LAYER IONIZATION ON THE INFLUX OF
        SOLAR ENERGY INTO THE ATMOSPHERE, Geomagnetism and
        Aeronomy, Vol. 2, 1962, pp. 400-405.

        On the basis of a study of the time and latitudinal distribution
        of the daily ionization increment in the F_2-layer, it is shown that the
        state of ionization strongly depends on the influx of solar energy into
        the earth's atmosphere. The annual anomaly in the variation of
        critical frequencies, as compared to a simple layer, correlates well
        with the annual variation of the influx of solar energy into the earth's
        atmosphere according to data from middle-latitude stations.

        The phenomenon of the limitation of the increase of ionization in
        the F_2-layer is examined. It is shown that such phenomena essentially
        affect the correlation between the state of ionization of the F_2-layer
        and solar activity.

75.   Likhter, Ya. I.,
       CYCLIC INTENSITY VARIATIONS OF ATMOSPHERICS, Geomagnetism
       and Aeronomy, Vol. 6, 1966, pp. 614-616.

       Observational data obtained at Pretoria, Khabarovsk, and
       Kühlungsborn (E. Germany) show an inverse relationship with
       solar activity.

76.   Lyon, A. J.,
       THE BELT OF EQUATORIAL SPREAD-F, Journal of Atmospheric
       and Terrestrial Physics, Vol. 19, 1960, pp. 145-159.

       An investigation was made of the morphology of the belt at
       sunspot maximum, using IGY data for magnetically quiet and for
       magnetically disturbed conditions. Throughout the whole belt
       (from 30°S to 30°N) there is an inverse correlation between
       spread-F incidence and magnetic activity, but there is a positive
       correlation between the former and the post-sunset rise of the base
       of the layer. Hydromagnetic disturbances may account for some of
       the observed facts.

77.   MacLeod, M. A.,
       SPORADIC E THEORY. I. COLLISION-GEOMAGNETIC
       EQUILIBRIUM, Journal of the Atmospheric Sciences, Vol. 23,
       1966, pp. 96-109.

       A simple equilibrium theory of ionization transport in the
       ionosphere is described which predicts a tendency for thin layers
       of overdense ionization (sporadic E layers) to form in the E-region.
       Such layers can be produced by the dominance of any of five
       mechanisms of ionization convergence. Three of these mechanisms
       involve the neutral wind shear and two involve the neutral wind. The
       theory assumes that ambipolar diffusion of the electrons and heavy
       positive ions takes place under the influence of the forces due to
       neutral collisions and the geomagnetic field.

78.   Mergentaler, J.,
       SOLAR FACULAE AND IONOSPHERE, Acta Astronomica, Vol. 13,
       1963, pp. 249-252.

       The author discusses the hypothesis that the correlation between
       the activity index of the F-layer and solar faculae has a trend

opposite to that of the correlations between the ionosphere indices I_{F_2} and Ch_E, and between sunspot relative numbers and intensity of the 10.7 cm radio emission. The coefficients in the linear relations of the I_{F_2} index, the faculae areas, and the spot group number were calculated. The different indices of solar activity are subject to long-period variations showing both increases and decreases relative to the ionospheric activity.

79. Minasyan, G. N.,
IONOSPHERE AND GEOMAGNETIC EFFECTS OF LARGE CHROMOSPHERIC FLARES, Geomagnetism and Aeronomy, Vol. 1, 1961, pp. 675-680.

The velocity of particles released by the sun during large chromospheric flares is studied from the anomalous absorption over the polar cap and in the auroral zone, as well as from the behavior of the particles during a geomagnetic storm of the SC type. Experimental and theoretical curves are constructed showing the dependence on the depression of the geomagnetic field during the storm of the shift of the southern edge of the region of anomalous absorption. The radius of the "forbidden" cavity during the storm is computed for two values of the flux density (10^2 and 10^3 cm^{-3}).

80. Minnis, C. M.,
A NEW INDEX OF SOLAR ACTIVITY BASED ON IONOSPHERIC MEASUREMENTS, Journal of Atmospheric and Terrestrial Physics, Vol. 7, 1955, pp. 310-321.

The monthly, mean relative sunspot number (R_M) is assumed to contain a component (R_v) which has a one-to-one correlation with the critical frequency of the F_2-layer in an undisturbed ionosphere and which is, therefore, an idealized index of solar activity. The residual component (R_x) may be regarded as an error which has a Standard Deviation of about 20 percent. A new index (I_{F_2}) has been constructed for the period of 1938 to 1954; like R_M, it can also be regarded as giving an approximate value of R_v, but its residual error component (R_z) has a Standard Deviation, which is only about 1/10 that of R_x. The magnitude of I_{F_2} for a given month is computed from the mean-noon critical frequencies in the F_2-layer at Slough, Huancayo,

and Watheroo, which are normally available within a few weeks of the end of each month. The index is based, in effect, on a calibration of the F_2-layer critical frequencies at these observatories in terms of R_v, using data extending back as far as possible. Precautions have been taken to reduce to negligible proportion the effects of ionospheric disturbances on the magnitude of the new index.

81. Minnis, C. M. and Visser, S. W.,
BEHAVIOUR OF THE PRESENT SUNSPOT CYCLE, Nature, London, Vol. 182, 1958, pp. 1599-1600.

In disagreement with the previous results of Visser (1954), it is found that monthly mean values of ionospheric indices I_E and I_F show from January 1955 onwards a significant positive correlation with the rotational mean values of sunspot number. Likewise, a similar agreement exists for the I_{F_2} index during the period 1947 to 1950, also referred to by Visser. The latter author, in reply, admits the use of unsuitable data (de Bilt I indices), but points out the secondary post-maximal oscillations of the sunspot number with a period of ~ 1 year in 1947 to 1950, which appear to be characteristic of all cycles, though showing a broad scatter of from 6 to 19 synodic months: thus, there is no evidence of a regular quasi-annual period.

82. Minnis, C. M. and Bazzard, G. H.,
SOME INDICES OF SOLAR ACTIVITY BASED ON IONOSPHERIC AND RADIO NOISE MEASUREMENTS, Journal of Atmospheric and Terrestrial Physics, Vol. 14, 1959, pp. 213-228.

The critical frequencies of the E- and F_2-layers of the ionosphere are closely controlled by the level of solar activity, but, at any fixed point on the earth's surface, they also vary with season owing to the annual change in the solar-zenith angle. A critical frequency can only be used to provide an index of solar activity if such seasonal variations can be eliminated or reduced to very small proportions. Methods of achieving this are described and monthly mean values of an E- and an F_2-layer index are tabulated for the period of 1938 to 1957. The correlation of these indices with each other and with the solar noise flux at $\lambda 10 \cdot 7$ cm is high. Some possible practical applications of such indices are discussed briefly.

83.   Minnis, C. M. and Bazzard, G. H.,
        A MONTHLY IONOSPHERIC INDEX OF SOLAR ACTIVITY BASED
        ON F_2-LAYER IONIZATION AT ELEVEN STATIONS, Journal of
        Atmospheric and Terrestrial Physics, Vol. 18, 1960, pp. 297-305.

        A monthly index has been constructed, for the period 1938 to date,
using monthly mean or median noon values of $f_0 F_2$ at eleven widely-
distributed stations. The correlation between $f_0 F_2$ at noon and this
index is significantly greater than that between $f_0 F_2$ and either the
3 month weighted mean sunspot number or the monthly mean solar
radio noise flux at 2800 Mc/s. Numerical estimates have been made
of the errors incurred in forecasting noon and midnight $f_0 F_2$ several
months ahead using those three indices as guides to the trend of solar
activity.

84.   Misyura, V. A., Migunov, V. M., and Solodovnikov, G. K.,
        VARIABILITY OF THE IONOSPHERE, Geomagnetism and Aeronomy,
        Vol. 6, 1966, pp. 723-725.

        The authors determined the variability of the ionosphere by
differentiation with respect to time of the diurnal variation of the
total number of electrons, $N_0(t)$, in a vertical column of the ionosphere
of unit cross section in a fixed position, and computed the regular
component of $\partial N_0/\partial t$ for various times of the day and various states
of solar activity. Estimation shows that the irregular component of
variability is one or even two orders of magnitude smaller than the
regular one. Satellite data (Elektron I) were used.

85.   Naismith, R., Bevan, H. C., and Smith, P. A.,
        A LONG TERM VARIATION IN THE RELATIONSHIP OF SUNSPOT
        NUMBERS TO E-REGION CHARACTER FIGURES, Journal of
        Atmospheric and Terrestrial Physics, Vol. 21, 1961, pp. 167-173.

        During the last 25 years there has been a progressive increase
in sunspot numbers at the maximum of each cycle. Over the same
period ionospheric measurements indicate that the E-region ionization
corresponding to a given sunspot number has decreased. This change
has necessitated an adjustment of the empirical constants in the
expression relating sunspot numbers to E-region character
figures which is used in forecasting E-region critical frequencies.

86.   Naismith, R. and Smith, P. A.,
        FURTHER EVIDENCE OF A LONG TERM VARIATION IN THE
        RELATIONSHIP OF SOLAR ACTIVITY TO THE IONOSPHERE,
        Journal of Atmospheric and Terrestrial Physics, Vol. 22, 1961,
        pp. 270-274.

        Ionospheric measurements indicate that during the last 20 years
        there has been a progressive decrease in F-region ionization cor-
        responding to a given sunspot number. In a previous paper it was
        shown that there was a corresponding decrease in the E-region.
        It is pointed out that this represents a progressive change in the
        nature of solar radiation or in the atmosphere.

87.   Nestorov, G. and Taubenheim, J.,
        INVESTIGATION OF THE E LAYER OF THE IONOSPHERE AT
        THE TIME OF THE SOLAR ECLIPSE OF 15 FEBRUARY 1961,
        Geomagnetism and Aeronomy, Vol. 3, 1963, pp. 224-229.

        The repeatedly discussed problem of the simultaneous determina-
        tion during a solar eclipse of the effective recombination rate and
        the distribution of sources of ionizing radiation on the solar disk can
        be solved when local sources are eclipsed separately in time. An
        estimate has been made of the critical frequencies f_0E of the normal
        E layer, measured at Sofia and Nessebar (Bulgaria) at the time of
        the total eclipse of 15 February 1961. The effective recombination
        rate of the E layer was $\alpha_E = 10^{-7}$ cm $\cdot$ sec^{-1}. This value gives a
        relative variation of the intensity of ionizing radiation at the time
        of the eclipse almost corresponding to the simultaneous recording of
        solar radio emission at λ = 20 cm. This confirms the soundness
        of the assumption that 43 percent of the ionizing energy was radiated
        by two local regions at the eastern and western limbs of the solar
        disk near its equator.

88.   Nestorov, G., Křivský, L., and Letfus, V.,
        IONOSPHERIC ANOMALIES AS INDICATORS OF IONIZING
        RADIATION FROM A CORPUSCULAR CLOUD AFTER A SOLAR
        CHROMOSPHERIC FLARE, Geomagnetism and Aeronomy, Vol. 4,
        1964, pp. 822-824.

        A sharp increase in solar radio emission in the decimeter and
        meter ranges as well as an increase in cosmic radio noise at a
        frequency of 29 Mc/s and of atmospheric radio noise at a frequency
        of 27 kc/sec were recorded at the Ondrejov astronomical observatory

after the solar chromospheric flare of importance 2+ on September 16, 1963. Several hypotheses are advanced to explain this case.

The nature of the phenomena that occurred after the flare is investigated on the basis of data for ionospheric absorption of long, medium, and short waves, obtained at Sofia during the same period.

89. Nikol'skiy, A. P.,
     RELATIONSHIP BETWEEN MAGNETIC ACTIVITY AND
     DISTURBANCES IN THE F_2 LAYER OF THE IONOSPHERE,
     Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 106-107.

     At high latitudes (Anchorage, Cape Wellen, Tixie Bay) the
     forbidden interval for the beginning of ionospheric disturbances
     corresponds closely to that for magnetic disturbances.

90. Noci, G.,
     IONOSPHERIC EFFECTS DUE TO THE EARTH'S ORBITAL
     POSITION, Nature, London, Vol. 199, 1963, pp. 968-969.

     The ellipticity of the earth's orbit accounts for a variation of
     6.5 percent during the year in the E-layer of the ionosphere (see
     Appleton, item 2). The measured variation of 7.5 percent is
     explained as resulting from superposition of a double-wave. It is
     further shown that several terrestrial-solar processes (number of
     aurorae borealis, intensity of zodiacal light, geomagnetic distur-
     bances) also fluctuate in annual double-waves.

91. Novish-Bylinskaya, V. N.,
     CYCLIC CURVES OF CRITICAL F_2-LAYER FREQUENCIES AS A
     BASIS FOR FORECASTING $f_0 F_2$ FOR ANY PHASE OF THE SOLAR
     CYCLE, Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 312-314.

     Critical F_2-layer frequency data, obtained at a network of
     ionospheric stations during three cycles (1934-1964), were analyzed.
     From the results it can be concluded that the plotted, smoothed
     cyclic $f_0 F_2$ curves represent a forecast of $f_0 F_2$ for an entire solar
     activity cycle with a maximum at relative sunspot numbers, R,
     from 110 to 150.

92. Odintsova, I. N.,
     EFFECTS OF SOLAR FLARES IN THE E AND D LAYERS OF THE
     IONOSPHERE, Geomagnetism and Aeronomy, Vol. 3, 1963,
     pp. 557-562.

A study has been made of the dependence of geoactive flares, which produced effects in the E and D layers, on their position on the solar disk and on time of day. It was found that flares are the most effective in the afternoon hours (13-15 hours LT). No dependence of the effectiveness of flares on their position on the solar disk was discovered.

A study has been made of the time dependence between the onset of the effect in the E and D layers and luminescence of the flare in H_α; the effect in the E region is observed simultaneously with the optical flare, whereas the effect in the D region begins somewhat later. However, in a number of cases the effect in the E region begins earlier than luminescence of the flare in H_α.

93.   Odintsova, I. N.,
       EFFECTS IN THE F_2-LAYER OF THE IONOSPHERE AT THE TIME
       OF SOLAR FLARES, Geomagnetism and Aeronomy, Vol. 3, 1963,
       pp. 909-911.

By comparisons with the mean value of f_0F_2 on three nearby days in each case, effects of solar flares (importances from 3 to 3+) were established. Three of the flares were accompanied by the arrival of fast particles with energies of 10 to 100 MeV in the polar cap, and by polar absorption of radio waves. However, it has been postulated that the effects in the F_2-layer are not caused by cosmic rays, but in all probability by unusual photon radiation arising in the flares.

94.   Odintsova, I. N.,
       ESTIMATE OF THE SPECTRUM OF IONIZING SOLAR RADIATION
       DURING THE FLARE OF AUGUST 22, 1958, ACCORDING TO
       VERTICAL SOUNDINGS OF THE IONOSPHERE, Geomagnetism and
       Aeronomy, Vol. 4, 1964, pp. 805-810.

From a study of N(h) profiles at heights from 100 to 320 km it was found that a considerable increase in electron concentration at the levels of the F_2 and E layers of the ionosphere took place during the flare. No noticeable increase in electron concentration was found at heights from 120-220 km. The ionization rate at heights from 100 to 320 km is computed for the time of the maximum of the effect. The data obtained are used to estimate the intensity spectrum of shortwave solar radiation < 1000 Å at the time of the flare.

95.   Oksman, J.,
        THE SUNSPOT CYCLE VARIATION OF THE IONOSPHERE IN
        FINLAND, Academia Scientiarum Fennica, Annales, Vol. A6,
        No. 200, 1966.

        From a statistical study of the results of hourly soundings of the
        ionosphere at Sodankylä and Nurmijarvi from 1957 to 1964, the period
        of decline of cycle No. 19, it was possible to establish regression
        curves of the critical frequencies of the regular layers of the
        ionosphere and of M3000F2 as function of the spot number.

96.   Olatunji, E. O.,
        IONOSPHERIC DIURNAL VARIATIONS IN THE F-LAYER AT
        IBADAN OVER A SUNSPOT CYCLE, Annales de Géophysique,
        Vol. 22, 1966, pp. 393-395.

        Data obtained during a solar cycle are used to depict the local
        time variation of $f_0 F_2$ and $h_m F_2$ for an equatorial station.   Differences
        in variation at different solar epochs are illustrated.

        At sunspot maximum, the diurnal peak of $f_0 F_2$ variation occurs
        before noon while sunspot minimum exhibits a post-noon peak.   The
        variation of $h_m F_2$ retains the same form at all solar epochs.   The
        post-sunset increase of $h_m F_2$ is much more pronounced at sunspot
        maximum than at sunspot minimum.

97.   Orsini, L. Q. and Mazzilli, R. H.,
        SUDDEN INCREASE IN THE IONOSPHERE F_2-REGION
        IONIZATION ASSOCIATED WITH SOLAR FLARES, Nature, London,
        Vol. 193, 1962, pp. 462-463.

        Five cases are reported in which the F_2-layer ionization increased
        significantly shortly after the onset of flares.   In one case the strong
        absorption made it impossible to measure $f_0 F_2$ immediately after the
        flare.   The attachment coefficient β was estimated to be between
        3.6 and $5.4 \times 10^{-4} \sec^{-1}$ at 315km in one of the events.

98.   Paetzold, H. K.,
        CORPUSCULAR HEATING OF THE UPPER ATMOSPHERE,
        Journal of Geophysical Research, Vol. 67, 1962, pp. 2741-2744.

Reduction of data on orbital changes of seven satellites (1958α, $1958\beta_1$, $1958\beta_2$, $1959\alpha_1$, $1959\alpha_2$, 1959η, and $1959\iota_1$) during several years showed considerable heating of the upper atmosphere with the period of the sunspot cycle. It is shown that shortwave UV contributes two thirds, and solar wind one third of the heating.

99. Pick, M.,
RELATIONS BETWEEN CERTAIN FORMS OF IONOSPHERIC ABSORPTION AND SOLAR AND GEOPHYSICAL PHENOMENA, Annales de Géophysique, Vol. 22, 1966, pp. 310-319 (In French).

The principal optical and radio-electrical characteristics of solar flares, which account for PIDBs, PCAs, and SSCs, are clarified. Probabilities of these events are given. The optical and radio-electric import of flares are compared.

100. Piddington, J. H.,
SOME IONOSPHERIC EFFECTS OF THE SOLAR WIND, Institution of Telecommunication Engineers, Journal, India, Vol. 10, 1964, pp. 285-291.

The mechanism by which the solar wind affects the ionosphere is by electrodynamic and hydromagnetic drift caused by pressure and by friction of the wind on the cavity. This causes widespread magnetospheric drift motions some of them into and out of the ionosphere. Other magnetospheric motions are caused by the quiet-day dynamo field Sq and by the Earth's rotation.

The magnetosphere itself is a large reservoir of ionization (much greater than the ionosphere) and the various motions cause increases and decreases of F-region electron density, thus accounting for many disturbances and anomalies.

101. Priester, W.,
SOLAR ACTIVITY AND BRAKING OF THE EARTH SATELLITES, Naturwissenschaften, Vol. 46, 1959, pp. 197-198 (In German).

The fluctuations of the anomalistic period of the satellite 1957β show, in December 1957 and January 1958, a very close correlation with the 20-cm radiation of the sun; the parallelism of the curves is particularly distinct when the perigee is on the daytime side of the earth. It is possible to explain this by heating of the ionosphere by short-wave x-rays emitted from corona condensations, and

possibly connected with increased corpuscular radiation that also conforms to the 20-cm radiation.

102.   Rangaswamy, S. and Kapasi, K. B.,
        EQUATORIAL SPREAD-F AND SOLAR ACTIVITY, Journal of
        Atmospheric and Terrestrial Physics, Vol. 26, 1964, pp. 871-878.

        The effect of solar activity on equatorial spread-F has been
        studied using the published tables of $f_0 F_2$ from six Afro-Asian
        stations. The strong negative correlation between equatorial
        spread-F and magnetic activity observed during sunspot maximum
        is no longer significant during low sunspot years. On the contrary,
        a positive correlation between occurrence of equatorial spread-F
        and magnetic activity is observed in winter of low sunspot years.
        Similar variations in h'F are also observed with respect to geo-
        magnetic and solar activity. A severe reduction in the width of the
        belt of equatorial spread-F occurs in low sunspot years.

103.   Rao, C. S. R. and Benjamin, P.,
        A STUDY OF IONOSPHERIC CHARACTERISTICS AT TRIVANDRUM
        DURING HIGH AND LOW SUNSPOT ACTIVITY PERIODS, Institution
        of Telecommunication Engineers, Journal, India, Vol. 12, 1966,
        pp. 63-69.

        Data of the period of low activity of sunspots about the middle
        of the IQSY are presented.

104.   Rapoport, V. I. and Eydman, V. Ya.,
        RADIO NOISE ORIGINATING IN THE IONOSPHERE DURING
        IONIZATION BY CORPUSCULAR STREAMS, Geomagnetism and
        Aeronomy, Vol. 5, 1965, pp. 729-730.

        Elementary estimates show that ionospheric radio noise cannot
        be explained by Čerenkov or synchrotron radiation mechanisms;
        apparently it is associated with the penetration of strong corpuscular
        streams into the ionosphere where the fast particles of the streams
        detach electrons from molecules, resulting in decimeter and meter
        wave emission.

105.   Rastogi, R. G.,
        THE EQUATORIAL ANOMALY IN THE F_2 REGION OF THE
        IONOSPHERE, Institution of Telecommunication Engineers, Journal,
        India, Vol. 12, 1966, pp. 245-256.

A study of solar activity, seasonal and diurnal variation, moon phase, different altitudes of the ionosphere, and of longitude variations in the region of the equatorial anomaly is presented.

106.   Reber, G.,
         SOLAR ACTIVITY CYCLE AND SPREAD F, Journal of Geophysical Research, Vol. 63, 1958, p. 869.

It has been shown[1,2] that spread F at certain places varies in a manner associated with solar activity. Since 1954, the spread F over Hawaii has been steadily decreasing for all seasons. The winter characteristic for 1957 to 1958 shows only about 5 percent of the occurrences of 1953 to 1954. The summer characteristic also has decreased, but at a slower rate, so that the summer 1957 occurrences are markedly larger than either winter 1956 to 1957 or 1957 to 1958. Thus, Kihei is now a southern hemisphere station, similar to the situation in 1947 to 1948. The spread F equator passed by, moving northward about equinoxes 1956. At solar activity minimum, there is less spread F at the equinoxes than at either of the solstices. At solar activity maximum, the spread F during the equinoxes is midway between the larger summer and smaller winter values. All these features are close repetitions of the previous cycle, which lends confidence in the interpretation. The most interesting feature is a new rise in spread F during summer 1958 compared to 1957, bringing the phenomenon up to near the level of summer 1956. If this be real, then the logical inference is that we passed through the peak of the solar activity cycle during the winter 1957 to 1958 and are now on the down grade. Perhaps spread F is a sensitive and rapid manner of estimating extremes of solar activity.

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[1]G. Reber, SPREAD F OVER HAWAII, Journal of Geophysical Research, Vol. 59, 1954, pp. 257-265.

[2]G. Reber, WORLD-WIDE SPREAD F, Journal of Geophysical Research, Vol. 61, 1956, pp. 157-164.

Note: Because of its brevity, the preceding item is reproduced in full.

107. Reid, J. H.,
ON THE TIME-LAG BETWEEN FLARE AND SEA MAXIMA,
Journal of Atmospheric and Terrestrial Physics, Vol. 28, 1966,
pp. 677-679.

New data are given for the quantities that play an important part
The time-lag between the maximum of the solar flare and of
SEA on 28 March 1958 was 30 seconds at Ondrejov, and one minute
at Edinburgh. This discrepancy may be in part the result of
geographical factors, but it seems that the distance from the station
to the center of the perturbation is equally important.

108. Rishbeth, H.,
F_2-LAYER RATES AT SUNSPOT MINIMUM, Journal of Atmospheric
and Terrestrial Physics, Vol. 28, 1966, pp. 911-918.

New data are given for the quantities that play an important part
in the theory of the F_2-region; they are the ion-atom exchange
coefficient, the neutral-diffusion coefficient, and the flux of ionizing
radiation. These data are combined with several of the published
ionosphere models for calculation of theoretical values of the
maximum electron density at noon $N_m F_2$ and of the altitude of this
maximum at very low solar activity.

109. Rodionov, Ya. S.,
AUTOCORRELATION OF CRITICAL FREQUENCY FLUCTUATIONS
AND IONIZATION DENSITY, Geomagnetism and Aeronomy, Vol. 3,
1963, pp. 792-796.

Autocorrelation characteristics over one-day periods are
examined, and shortcomings of the analysis of the autocorrelation
function are pointed out. Although a variety of characteristics was
obtained, it was possible to conclude that the averaged summer and
winter characteristics differ in abruptness of decrease and in
increase in correlation at the end of the 24-hour periods. Further,
the residual correlation after 24 hours is positive as a rule and
averages 0.20; it does not correlate with the monthly average sunspot
number $\bar{R}$.

110. Römer, M.,
THE DENSITY OF THE UPPER ATMOSPHERE AND ITS
VARIATIONS DURING THE PHASE OF DECREASING SOLAR
ACTIVITY 1958-1962, Universitäts Sternwarte Bonn, Veröffentlichungen,
No. 68 (In German).

The density was determined from changes in the orbits of nine satellites at altitudes between 350 and 1500km, taking into consideration the diurnal variation. Analysis of the 27-day variation showed that within the accuracy of the data, it is the same during strong and weak solar activity if the time of the day is considered. The amplitude of the semi-annual variation decreases with decreasing solar activity, conforming to the findings of Paetzold and Jacchia. As compared to the theoretical models by Harris and Priester, the observed density is clearly greater than predicted for weak solar activity, but only slightly lower than in the appropriate model for strong solar activity. Density values found in the orbit of Echo I are higher than in the models by Harris and Priester, which may be due to greater concentration of He.

111. Schmelovsky, K. H. and Cumme, G.,
THE VARIATIONS OF TOTAL IONOSPHERIC ELECTRON CONTENT UP TO 1000 km BETWEEN SUNSPOT MAXIMUM AND MINIMUM, Zeitschrift für Meteorologie, Vol. 18, 1965, pp. 176-179.

The results of observations made from September to November 1963 were compared with those of 1958 to 1959. The diurnal variation presents the same appearance, but the values measured in 1963 are very much weaker than those measured in 1958-1959. Besides the regular variations, irregular ones have been observed the interpretation of which presents difficulties.

112. Serafimov, K. B.,
THE VARIATIONS OF MAXIMAL ELECTRON PRODUCTION AND THE IONIZING RADIATION IN THE F-LAYER AS FUNCTIONS OF SOLAR ACTIVITY, Pure and Applied Geophysics, Vol. 61, 1965, pp. 152-157 (In German).

The existence of temperature gradients and temperature variations in the high atmosphere changing the linear dependence between the variation of the maximal electron production in the F_1 layer and the relative sunspot number is shown. The intensity of the ionizing source varies extremely with the increase of the solar activity. In order to obtain sensible data it is necessary to use only the mean of the penetration frequency of the F_1 layer in the midday hours of the summer season.

113.   Serafimov, K. B.,
ON THE RELATION BETWEEN THE E-LAYER AND THE SUN,
Gerlands Beiträge zur Geophysik, Vol. 75, 1966, pp. 222-230
(In German).

Some expressions are deduced for the variations of the E-layer
critical frequency conditioned by the solar zenith angle, taking into
account the influence of the transport, the gradient and the variations
with time of the height scale. Taking into consideration the seasonal
changes of the recombination coefficient and the height scale it is
theoretically confirmed that the daily value of the index n of the
cosine law for the E-layer does not coincide with the noon value;
however, there is a high degree of correlation between the n values
and the solar x-ray emission in the range from 44 to 60A, the
correlation coefficient being 0.82.

114.   Shchepkin, L. A.,
SOME CHARACTERISTICS OF CYCLIC F_1-LAYER VARIATIONS
OVER IRKUTSK, Geomagnetism and Aeronomy, Vol. 1, 1961,
p. 549.

The author examines the relationship between the F_1-layer
frequency and the Wolf number.

115.   Shchepkin, L. A.,
LATITUDINAL CHANGE OF CONDITIONS FOR OCCURRENCE OF
THE F_1-LAYER, Geomagnetism and Aeronomy, Vol. 3, 1963,
pp. 847-851.

The author discusses the possible reasons for the latitudinal
effect under consideration on the basis of the role of splitting of the
maximum of ion formation in the F region of the ionosphere in the
formation of the F_1 layer. The study is based on conditions during a
period of high solar activity at solstitial periods. The same
conclusions resulted from a study of changes in the seasonal
development of the F_1-layer, namely that the probability of its
occurrence increases when the sun is low above the horizon.

116.   Shchepkin, L. A.,
THE F_1-LAYER DURING A PERIOD OF DECREASING SOLAR
ACTIVITY, Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 30-33.

The latitudinal distribution is examined of values characterizing the average diurnal probability of observation of the F_1-layer and the relative number of observations of a fully developed layer, of the cosines of the zenith angle of the sun corresponding to the beginning of reliable observation of the layer in its seasonal and diurnal development, and of the coefficients of asymmetry of the diurnal variation of the frequency of observation of the layer. The latitudinal variations and the magnitudes of the parameters in question are compared with analogous data for a period of high solar activity.

117.   Shirke, J. S. and Alurkar, S. K.,
        SOLAR FLARE (S.I.D.) EFFECTS ON THE PROPAGATION OF
        164kHz RADIO WAVES FROM TASHKENT TO AHMEDABAD,
        Academy of Sciences, Indian, Proceedings (A), Vol. 57, 1963,
        pp. 49-68.

        Since March 1960, regular recording of field strengths of
        Tashkent radio transmissions on 164 kc/s was made at Ahmedabad.
        The paper contains an analysis of the 115 sudden ionospheric
        disturbances (SID s) which were recorded during the period March to
        December 1960. Only a few of them were associated with visible
        solar flares. Many of the SID s occur simultaneously with SCNA s
        (sudden cosmic noise attenuations) on 25 Mc/s, which were also
        recorded continuously. On some occasions when the altitude of the
        sun is low, there is a weakening of the l.f. signal a few minutes
        before the onset of the noise burst or SCNA. An explanation of the
        observed phenomena is suggested.

118.   Shul'gina, N. V.,
        OBSERVATIONS OF IONOSPHERIC DISTURBANCES AT
        MURMANSK, Geomagnetism and Aeronomy, Vol. 2, 1962,
        pp. 728-734.

        Investigations of ionospheric disturbances during the period
        January 1954 through January 1960 have shown that the character of
        ionospheric disturbance changes with an increase in solar activity.
        This article considers the problem of the indices of disturbance and
        their dependence on Wolf numbers W. Disturbances were classified
        by duration and the character of their development. It was found
        that in a year of minimum activity they are short in duration and
        almost always appear in the lower layers of the ionosphere; in a
        year of maximum activity the duration of disturbances increases and
        affects all layers of the ionosphere.

119.   Singler, A.,
        HARMONIC ANALYSIS OF THE DIURNAL VARIATION OF CRITICAL
        F_2-LAYER FREQUENCIES, Geomagnetism and Aeronomy, Vol. 5,
        1965, pp. 806-812.

        The diurnal variation of critical F_2-layer frequencies is
        investigated with the view of determining its dependence on season
        and solar activity. The results show that the diurnal pattern changes
        continuously with the season and with the solar cycle and it can be
        represented with a good approximation by means of simple empirical
        interpolation formulas.

120.   Singler, A.,
        STUDY OF THE SCATTER OF THE NORMAL DIURNAL VARIATION
        OF CRITICAL F_2-LAYER FREQUENCIES (IONOSPHERE),
        Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 26-29.

        Knowledge of irregular fluctuations in the diurnal variation of
        F_2-layer ionization is important for forecasting the propagation of
        short radio waves. The limit of these fluctuations can be computed
        as a function of season and of the phase of the solar cycle by expanding
        in a series the individual diurnal f_0F_2 variations. The results show a
        poorly defined annual variation and a quadratic dependence on the
        relative sunspot number.

121.   Smith, L. G.,
        IONIZATION BY LYMAN-α IN THE E-REGION AT SUNRISE,
        Journal of Atmospheric and Terrestrial Physics, Vol. 28, 1966,
        pp. 1195-1205.

        Rocket observations of electron density prior to ground sunrise
        are described. It is found that the initial increase of electron density
        in the upper E-region coincides with the illumination of that region
        by Lyman-α radiation. Assuming that nitric oxide is the constituent
        being ionized by this radiation, it is deduced that the concentration
        is $(8 \pm 1) \times 10^6$ cm^{-3} between 130 and 150 km, in good agreement with
        theoretical estimates.

122.   Stubbe, P.,
        TEMPERATURE VARIATION AT THE F-LAYER MAXIMUM
        DURING A SUNSPOT CYCLE, Journal of Atmospheric and
        Terrestrial Physics, Vol. 26, 1964, pp. 1055-1068.

The half-thickness and the height of the upper boundary of the F_2-layer as determined at Lindau between 1953 and 1960 are related to the Zürich sunspot relative number. The author explains this by a temperature increase by a factor of 1.4 at the upper boundary of the F_2-layer between minimum and maximum of the spot activity, and by a simultaneous increase of the height of the upper boundary by a factor of 1.7. Comparable results of satellite measurements are cited.

123.   Sukhorukova, E. V.,
ELECTRON CONCENTRATION OVER MURMANSK AT VARIOUS SOLAR ACTIVITY LEVELS, Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 305-309.

Characteristics of solar radiation are reviewed, and the physical parameters of the medium that determine ionization are examined. It is found that the ionization profile changes in such a manner during the solar cycle that the level where the electron concentration maximum is observed rises from the solar activity minimum to the maximum by about 100 km, and the height dividing the area of the N(h) into the lower quarter and the upper three quarters changes by about the same amount. The difference between h_{max} and h_i increases from winter to summer, but changes little from year to year.

124.   Svechnikov, A. M., Chavdarov, S. S., and Chernysheva, S. P.,
STABILITY OF REFLECTIONS FROM THE SPORADIC E LAYER AND RADIO WAVE ABSORPTION DURING THE SOLAR CYCLE, Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 440-443.

As the radio absorption in the ionosphere is directly correlated with the characteristic number W of solar activity, an investigation was made if there is an inverse correlation between this activity and the stability of reflection by E_s as a result of the absorption. Correlations were established in the diurnal, seasonal, and long-period patterns of the correlations between Θ, L, and W, and the decrease of absorption with decreasing solar activity appears insufficient to explain the increase of the stability coefficient.

125.   Thomas, L.,
THE IMPORTANCE OF PHOTOIONIZATION IN THE PRODUCTION OF THE DAYTIME F-REGION AT HIGH LATITUDES DURING WINTER, Planetary and Space Science, Vol. 14, 1966, pp. 891-899.

The author reports on his research on the distribution of electron densities calculated for numerous zenith angles and taking into account the values of ionospheric parameters that are appropriate for solar maximum and minimum in an isothermal atmosphere with thermal equilibrium between neutral gas, ions, and electrons. Modifications resulting from temperature differences among these components are considered.

126. Vasil'yeva, T. N.,
PARAMETERS OF THE LINEAR DEPENDENCE OF f_0F_2 AND M-3000-F2 ON SOLAR ACTIVITY, Geomagnetism and Aeronomy, Vol. 4, 1964, pp. 540-544.

Data from the world network of ionospheric stations have been used in a study of the dependence of f_0F_2 and $M-3000-F_2$ on solar activity during a change of R from 0 to 100. For each 10° zone of geomagnetic latitude the author has compiled tables of the parameters of linear dependence, being the initial data for preparation of a prediction of the maximum usable frequency in the form of world maps, using an electronic computer. There is a discussion of the pattern of change of f_0F_2 and $M-3000-F_2$ with an increase of solar activity for different latitudes.

127. Vasil'yeva, T. N. and Kerblay, T. S.,
VARIOUS TYPES OF DEPENDENCIES OF f_0F_2 ON SOLAR ACTIVITY, Geomagnetism and Aeronomy, Vol. 4, 1964, pp. 669-671.

The dependence of f_0F_2 on solar activity R for R from 0 to 200 is analyzed on the basis of data from the world network of ionospheric stations. Three types of dependencies are examined: I — the linear function f_0F_2 of R in the entire range of R, II — the limitation of the increase of f_0F_2 at high solar activity, and III — the increase in the growth of f_0F_2 with high solar activity. The pattern of appearance of these types is examined. The possible applications of the conclusions derived to the computation of F_2-muf on an electronic computer are indicated.

128. Vasil'yeva, T. N.,
CHARACTERISTICS OF f_0F_2 VARIATIONS AT HIGH SOLAR ACTIVITY, Geomagnetism and Aeronomy, Vol. 5, 1965, pp. 870-872.

In this article the percentage distribution of the various types of dependence of f_0F_2 on the sunspot number R is examined. The purpose

of the study was to establish if two sub-groups of Type II (in which the frequency remains constant, starting from a certain R value) have some distribution pattern, or if they should be ascribed to observational deficiencies. Both sub-groups were found to be real, Type IIa being characteristic of transitional periods, and Type IIb of not only limited growth of f_0F_2 but also of inverse dependence of f_0F_2 on solar activity.

129.   Venugopal, V. R.,
        VARIATION OF THE F_2-LAYER IONIZATION WITH SOLAR
        ACTIVITY AT KODAIKANAL ON MAGNETICALLY DISTURBED
        AND QUIET DAYS, Kodaikanal Observatory, Bulletin, No. 151,
        1959.

        The noon-time, critical frequencies of the F_2-layer observed at Kodaikanal during the years 1952 to 1957 are compared with the sunspot relative numbers, the spot areas, and the areas of the Ca-flocculi. In all three cases, a close, linear relation was found between the limiting frequency and the respective solar-activity indicator. In particular, the limiting frequency was higher during magnetically disturbed days than during quiet ones, and a definite seasonal effect could be found.

130.   Vice, R. W.,
        STUDIES OF THE LOWER IONOSPHERE OVER A COMPLETE
        SOLAR CYCLE, Institution of Telecommunication Engineers, Journal,
        India, Vol. 12, 1966, pp. 192-197.

        Data are presented of measurements of the absorption, the virtual height, of partial reflections and the interaction of waves for determination of the electron density and of the collision frequency.

131.   Vinogradov, Yu. I.,
        THE CONNECTION BETWEEN THE IONOSPHERIC SPORADIC
        E-LAYER AND SOLAR FLARES, Izvestiya Krymsk, Astrofiz. Obs.,
        Vol. 34, 1965, pp. 319-327 (In Russian).

        This article presents a study of data obtained in 1958-1959 at the Crimean Astrophysical Observatory and their connection with the variations of the critical frequency of the E-layer, flares, and solar radio emission.

132. Volland, H.,
ON THE SOLAR FLARE EFFECT OF V. L. F.-WAVES IN THE
LOWER IONOSPHERE, Journal of Atmospheric and Terrestrial
Physics, Vol. 26, 1964, pp. 695-700.

The change of the equivalent reflection height h' with time has
been determined from 15 selected solar flare effects of the trans-
mitter GBR (16 kc/s) measured in Berlin. With help of a plausible
ionospheric model it is possible to attach to each height h' a
corresponding electron density N. The parameters of an effective
recombination law and an effective attachment law have been
determined from the course of h' with time. If the normal D-layer
becomes simply strengthened during a solar flare only the attachment
law is applicable. The average effective attachment coefficient is
$\beta = 3 \cdot 4 \times 10^{-3}$ sec^{-1} in 70 km height. If a new layer produced by
X-rays is built up during a solar flare below the normal D-layer the
recombination law obtains validity. The average value of the product
of the effective recombination coefficient α and the normal electron
density N_0 is $\alpha N_0 = 2 \cdot 9 \times 10^{-4}$ sec^{-1} in 70 km height.

133. Waddington, C. J.,
INCREASES OF IONIZATION IN THE F_2 LAYER AND SOLAR
CORPUSCULAR RADIATION, Nature, London, Vol. 193, 1962,
pp. 1272-1273.

Observations by Orsini and Mazzilli (item 97) and by others are
summarized. It is found that every large increase in F_2-layer
ionization reported thus far has been associated with an increase
in the cosmic radiation reaching the earth. Other measurements are
suggested and discussed.

134. Wagner, C.-U.,
THE ORIGIN OF IONIZATION IN THE LOW IONOSPHERE DURING
A SUNSPOT MINIMUM, Akademie der Wissenschaften, Deutsche,
Monatsberichte, Vol. 7, 1965, pp. 601-602 (In German).

Research on radiations effective at about 100km altitude, and on
the importance of the reaction $NO + h\nu \rightarrow NO^+ + e^-$ in the electronic
balance-sheet is reported.

135. Warwick, C. S. and Haurwitz, M. W.,
A STUDY OF SOLAR ACTIVITY ASSOCIATED WITH POLAR-CAP
ABSORPTION, Journal of Geophysical Research, Vol. 67, 1962,
pp. 1317-1332.

Forty-three PCA events are discussed in relation to unusual solar phenomena. The proton emission from the sun takes place together with particularly strong and long-lasting emission in the optical and rf ranges; the intensity of the PCA event depends mainly on the intensity of the burst in the 10-meter band. The solar phenomenon causing the PCA event almost always takes place on the visible side of the sun, but there is no noticeable effect due to location on the disk. The time interval between solar phenomenon and PCA event increases with solar activity because of the correspondingly increasing strength of the interplanetary field.

136.   Weeks, L. H., Smith, L. G., and Accardo, C. A.,
ROCKET MEASUREMENTS IN THE IONOSPHERE DURING THE
ECLIPSE OF JULY 20, 1963. I. D REGION, American Geophysical
Union, Transactions, Vol. 45, 1964, p. 48.

It was found that Lyman-α radiation is the principal source of ionization to altitudes between 72 and 83 km. The relation between electron density and duration of the obscuration was investigated.

Note: For measurements in the E region see item 1.

137.   Willmore, A. P.,
GEOGRAPHICAL AND SOLAR ACTIVITY VARIATIONS IN THE
ELECTRON TEMPERATURE OF THE UPPER F-REGION, Royal
Society of London, Proceedings, Series A, Vol. 286, 1965,
pp. 537-558.

Analysis of electron temperatures measured with satellite Ariel I confirmed that the observed variations are functions of latitude and altitude. The geographical variations differ at midnight, at noon, and at sunrise. A study was made of the influence of the variations in the solar emission of far UV.

138.   Willmore, A. P.,
IONOSPHERIC HEATING IN THE F-REGION, Royal Society of London,
Proceedings, Series A, Vol. 281, 1964, pp. 140-149.

Measurements of electron temperature made in Ariel I have been analyzed to calculate the ionospheric energy input required to maintain the electron temperature above the ion temperature. The results are found to be consistent with the energy input due to photo-ionization in the daytime, provided that allowance is made for the

effects of the escaping flux of photoelectrons spiralling upwards along the geomagnetic field lines which impart energy to the ionosphere by electron-electron interaction. However, it is found that during the night an energy input of particle origin is observed, a close agreement being found between the distribution of energy input and that of the fluxes of low-energy particles observed by Savenko, Shavrin & Pisavenko 1963. The particle flux contributes less than 30 percent to the heat input in the daytime and its diurnal variation is small.

139.   Yacob, A. and Prabhavalkar, A. S.,
        SOLAR CONTROL OF THE AMPLITUDE AND PHASE OF THE
        YEARLY MEAN Sq(H) AT ALIBAG FOR THE PERIOD 1905 TO 1960,
        Journal of Atmospheric and Terrestrial Physics, Vol. 27, 1965,
        pp. 73-80.

        The yearly mean diurnal variation of H at Alibag for the international quiet days is obtained for each of the years 1905-1960 and the first two harmonics of the variation derived by Fourier analysis. A study of the amplitudes and times of maximum of the first and second harmonics with respect to solar activity shows that (1) the amplitudes of both the harmonics have a good direct correspondence with sunspot numbers, (2) the maximum of the first harmonic occurs at a later time with increasing solar activity, while the time of maximum of the second harmonic shows no systematic relationship with sunspot number. The correspondence between the amplitudes and sunspot number should be the direct consequence of the increase with solar activity of the ionization intensity and therefore the conductivity of the E-region. The lag in the time of maximum of the first harmonic with increasing sunspot number appears to be connected with the relaxation time of the E-region, though no definite conclusions can be arrived at for want of sufficient data regarding the coefficient of recombination for E-layer heights.

140.   Yacob, A. and Radhakrishna Rao, D.,
        SOLAR CYCLE AND ANNUAL VARIATIONS OF Sq(H) AT ALIBAG,
        Journal of Atmospheric and Terrestrial Physics, Vol. 28, 1966,
        pp. 351-360.

        This article presents a study of the amplitudes and phase angles of the two first harmonics of the monthly average of Sq(H) and of the relation to the Wolf number R for the period from 1905 to 1960 and for the epochs of solar minima and maxima. These variations are the same for the two harmonics and for the solar maxima and minima. It is suggested that there is an action of atmospheric tides.

141. Yeh, K. C. and Flaherty, B. J.,
      IONOSPHERIC ELECTRON CONTENT AT TEMPERATE LATITUDES
      DURING THE DECLINING PHASE OF THE SUNSPOT CYCLE,
      Journal of Geophysical Research, Vol. 71, 1966, pp. 4557-4570.

      Values of the electron content obtained by observation of the
      Faraday effect during the period from July 1961 to October 1964
      are presented. The possible causes of seasonal anomalies are
      examined.

142. Yudovich, L. A.,
      CYCLIC VARIATIONS OF ABNORMAL IONIZATION OF THE F_2
      LAYER, Geomagnetism and Aeronomy, Vol. 4, 1964, p. 320.

      The maximum values of f_0F_2 were found to be noticeably reduced
      when solar activity is reduced, and the time of their appearance
      varies as solar activity decreases. Spiral distribution of the time
      of maximum values of f_0F_2 is maintained during years of a decline
      in solar activity.

143. Zevakina, R. A.,
      SPACE-TIME DISTRIBUTION OF AN IONOSPHERIC DISTURBANCE
      AT HIGH LATITUDES OF THE NORTHERN AND SOUTHERN
      HEMISPHERES AFTER LARGE CHROMOSPHERIC FLARES,
      Geomagnetism and Aeronomy, Vol. 3, 1963, pp. 62-69.

      Synoptic charts of the ionospheric disturbance (Δf_{min}, fE_s,
      and Δf_0F_2) in the Northern and Southern Hemispheres at the time
      of two very large disturbances on September 12-15 and 20-26, 1957,
      are examined.

      It is shown that the anomalous change in absorption as well as
      the increase in f_0F_2 occur approximately at the same time in the
      Northern and Southern Hemispheres. The decrease in f_0F_2 and the
      increase in fE_s spread over a larger area and are more stable in the
      Northern Hemisphere than in the Southern.

144. Zhulina, Ye. M.,
      DEVIATION OF CRITICAL FREQUENCIES ON QUIET AND
      DISTURBED DAYS FROM THE MONTHLY MEDIAN VALUE,
      Geomagnetism and Aeronomy, Vol. 3, 1963, pp. 569-571.

The data for 14 ionospheric stations situated at high and middle latitudes have been used to analyze the median values $f_0 F_2$ obtained separately for quiet and disturbed days and these values are compared with the median values for all days of the month.

The analysis was made for periods of high (1957-1958), medium (1961) and low (1954-1955) solar activity. It was found that large deviations relative to the median for all days of the month occur in the high latitudes in the winter and at the equinox in a period of high solar activity.

145.   Zhulina, Ye. M.,
VARIATION OF RADIO COMMUNICATION CHARACTERISTICS WITH THE SOLAR ACTIVITY CYCLE, Geomagnetism and Aeronomy, Vol. 5, 1965, pp. 876-879.

Data for years of maximum (1957-1959), decreasing, and minimum (1961-1963) solar activity were analyzed. The material consists of audio estimates of the quality of signals received from WWV and WWVH on all of their frequencies. The receiving stations were Ottawa, Churchill, and Resolute Bay; rating was on a 10-point scale. It is concluded that

1. during years of approaching minimum activity, the quality of radio communication deteriorates during the winter, being poorest at night, while it changes only insignificantly in summer,
2. the trend of the communication reliability follows the same pattern,
3. the agreement between the computed muf and the transmission on paths crossing the auroral zone is unsatisfactory.

See also:

Section III, items 3, 15, 27, 31, 37, 40, 41, 42, 47, 48, 51, 52, 56, 58, 61, 62.

Section IV, items 1, 9, 16, 34.

Section III. PARTICLE EMISSION AND ELECTROMAGNETIC RADIATION; GEOMAGNETISM

1. Akasofu, S.-I. and Yoshida, S.,
    THE STRUCTURE OF THE SOLAR PLASMA FLOW GENERATED BY
    SOLAR FLARES, Planetary and Space Science, Vol. 15, 1967,
    pp. 39-47.

    Characteristics of geomagnetic storms caused by solar flares at
    different central meridian distances are statistically examined to
    obtain a two dimensional configuration of the solar plasma flow gen-
    erated by solar flares.

    It is shown that the front of the plasma flow is nearly hemispher-
    ical, but its energy flux is greatly concentrated in a narrow cone from
    intense solar flares; therefore, the energy flux has a jet structure.
    It is shown that these results can be reasonably combined to give a
    consistent picture by assuming the generation of an interplanetary
    shock wave by the jet of the solar plasma ejected by a solar flare.

2. Archenhold, G. H.,
    INFLUENCE OF VARIABILITY OF MEAN LATITUDE OF SUNSPOTS
    ON RECURRENT TENDENCY OF MAGNETIC DISTURBANCES,
    Royal Astronomical Society, Monthly Notices, Vol. 99, 1939,
    pp. 721-729.

    It is pointed out that the recurrence interval of terrestrial mag-
    netic disturbances is definitely smaller in years preceding a sunspot
    minimum than in years following a minimum. The difference between
    each three years before and after a minimum is found to be 0 · 5 day
    with a mean error of ±0 · 14 day. The recurrence interval shortens
    continually from the beginning of the cycle to the end as is to be
    expected from the decline of the mean equator distance of the sun-
    spots. In years with sunspot zones, both near the equator and in
    higher latitudes, the shorter recurrence interval of the equator belt
    prevails, because disturbed areas of the sun's surface are the more
    effective on the earth's magnetism the smaller their mean distance
    from the equator.

3. Avignon, Y., Martres-Trope, M.-J. and Pick-Gutman, M.,
    IDENTIFICATION OF CLASSES OF CHROMOSPHERIC FLARES
    ASSOCIATED WITH EMISSION OF COSMIC RAYS AND ELECTRIC
    WAVES, Annales d'Astrophysique, Vol. 27, 1964, pp. 23-28 (In
    French).

This study was based on observations of 49 chromospheric flares during the years 1957 to 1961, and of the accompanying ionospheric PCA processes and radio emissions of type IV. Classification of these flares by the geometric configurations of their respective activity centers resulted in three configurations among which 34 of the 49 flares may be grouped.

4. Bell, B.,
   SOLAR RADIO BURSTS OF SPECTRAL TYPES II AND IV; THEIR
   RELATIONS TO OPTICAL PHENOMENA AND TO GEOMAGNETIC
   ACTIVITY, Smithsonian Contributions to Astrophysics, Vol. 5,
   1963, pp. 239-257.

Solar radio bursts of spectral types II and IV, observed in the years 1957 to 1960, are discussed in relation to flares, the magnetic class of the associated sunspot, the north-south asymmetry, and geomagnetic and solar proton (PCA) effects. A total of 96 type IV and 197 type II bursts were studied. About 50 percent of the type IV and 28 percent of the type II bursts were associated with a major ($\geq 2+$) flare. Sunspot groups of complex ($\beta\gamma$ and γ) magnetic class produced 61 percent of the type IV but only 36 percent of the type II bursts. Comparative data are given for sunspots, flares, and geomagnetic storm and PCA sources. The north-south asymmetry appears to increase with increasing intensity in various types of solar activity. Long-lived bursts of each type are more concentrated to the north than are short-lived bursts, but there is no significant difference between type II and type IV bursts in north-south distribution. The data indicate a very strong association between type IV bursts and great geomagnetic storms. The increase in probability of a great storm within three days after a type II burst is also significant but less striking. However, those type II bursts that were not accompanied by type IV appear to be significantly associated only with small storms. The bursts were subdivided by various properties. A major flare or a long duration of the burst each increases the probability of geomagnetic success. Type IV bursts lasting less than 15 minutes have little geomagnetic importance. Given a major flare with type IV emission, the magnetic class of the sunspot is of minor significance. However, a $\beta\gamma$ or γ sunspot is about five times more likely to produce a major flare with type IV emission than is a β or a spot group of comparable size.

The inverse problem of solar activity preceding geomagnetic storms was analysed as a function of storm intensity. A significant difference between recurrent and nonrecurrent storms was found in

that recurrent storms tend to avoid centers of major flare and radio burst activity. A strong association is found between type IV radio events and PCA events, with 23 of the type IV bursts followed by a PCA within a few hours. The duration of the burst is positively related to the intensity of the PCA. A high percentage of proton events arise from complex sunspot groups.

5.   Belmont, A. D., Dartt, D. G. and Ulstad, M. S.,
THE 10.7-CM SOLAR FLUX AND THE 26-MONTH OSCILLATION,
Journal of the Atmospheric Sciences, Vol. 23, 1966, pp. 314-319.

There is a direct correlation of the solar radio flux at 10.7 cm with the solar radiation in the extreme UV, the temperature of the thermosphere, the sunspots, and the solar cycles of 27 days and of 11 years. The question arises if there is also a relation with the 26-month cycle observed for the wind and the temperature in the tropical stratosphere. Harmonic analysis of the flux shows that in it no period of about 26 months exists.

6.   Bhatnagar, A. and Punetha, L. M.,
A STUDY OF SOME OPTICAL PHENOMENA ASSOCIATED WITH
SOLAR FLARES, Kodaikanal Observatory, Bulletin, No. 162,
pp. 317-328.

This article brings detailed descriptions of nine solar flares in the years 1926 - 1957. In some cases the abrupt disappearance of filaments can be explained by their sudden, very rapid motions which lead to Doppler displacements taking the filaments out of the wavelength range of the spectroheliograph. The position of the flares relative to their spot groups is discussed.

7.   Blum, R.,
THE INTERACTION BETWEEN THE GEOMAGNETIC FIELD AND
THE SOLAR CORPUSCULAR RADIATION, Icarus, Vol. 1, 1962,
pp. 459-488.

The author presents a survey of observations of solar particle radiation and geomagnetic storms. He discusses the pertinent theories including analogy considerations from the point of view of gas dynamics.

8. Bol'shakova, O. V.,
    VARIATION IN SOLAR WIND INTENSITY WITH PHASE OF SOLAR
    ACTIVITY CYCLE FROM DATA ON STABLE OSCILLATIONS OF THE
    GEOMAGNETIC FIELD, Astronomicheskii Zhurnal, S.S.S.R.,
    Vol. 42, 1965, pp. 859-861, Soviet Astronomy - AJ, Vol. 9, 1965,
    pp. 666-667.

    This mean amplitude of short-period oscillations (type pc4) of
    the geomagnetic field corresponding to a solar wind blowing from
    quiet solar regions (Kp = 0) remained constant over the 1957-1964
    period. The inference is drawn that the intensity of the solar wind
    from quiescent solar regions is unaffected by the phase of the solar
    activity cycle.

9. Broxon, J. W.,
    RELATION OF THE COSMIC RADIATION TO GEOMAGNETIC AND
    HELIOPHYSICAL ACTIVITIES, Physical Review, Vol. 62, 1942,
    pp. 508-522.

    Definite pulses, in both the magnetic character and sunspot areas,
    were found to be associated with the primary pulses in the cosmic
    radiation. They are in general phase opposition to the cosmic-ray
    pulses, but the tip of the magnetic-character pulse precedes the tip
    of the opposite cosmic-ray pulse by 1 day; the lead was 3 or 4 days
    in the opposed sunspot pulses. Direct application of Chree's method
    to the magnetic character and sunspot areas, individually, indicated
    a 27-day periodicity in the former and a 34-day periodicity in the
    latter. A second method of investigation yielded contradictory results:
    it indicated 27-day fluctuations in sunspot areas in phase with the
    cosmic-ray fluctuations and out of phase with changes in magnetic
    character.

10. Bruzek, A.,
    OBSERVATIONS ON THE RELATIONS BETWEEN FLARES AND
    SUNSPOT FIELDS, Zeitschrift für Astrophysik, Vol. 50. 1960,
    pp. 110-120 (In German).

    Within one large spotgroup there developed three great flares on
    16, 17, and 18 June 1959 and three 3+ flares on 10, 14, and 16 July
    1959. The relations between the development of these flares and the
    spot and its magnetic field were studied, and the findings were as
    follows:

1) The great flares appeared during periods of slowly and continuously proceeding important changes in spot and magnetic field structure. No connection could be found between any special phase of spot development and the onset of great flares.

2) In spite of considerable changes in the spot structure, all the flares originated at the same position relative to the spot umbrae and had almost the same shape.

3) The great flares and most of the minor ones originated at the edges of umbrae and near or on the "neutral line" of zero-longitudinal magnetic-field strength. This means that the flares originated in regions of strong magnetic field, frequently with a strong or even predominant transverse component, but never in "neutral points" of zero field of strength.

11. Charakhch'yan, A. N. and Charakhch'yan, T. N., NEW DATA ON COSMIC RAY BURSTS ON THE SUN, Geomagnetism and Aeronomy, Vol. 2, 1962, pp. 196-199.

New data lead to the conclusion that magnetic traps for protons exist in solar corpuscular streams. Data are derived characterizing the density and strength of the fields of magnetic clouds responsible for the scattering in interplanetary space of protons with an energy of ~ 0.2 Bev.

12. Charakhch'yan, A. N. and Charakhch'yan, T. N., COSMIC-RAY BURSTS IN THE STRATOSPHERE AND SOLAR CHROMOSPHERIC FLARES, Geomagnetism and Aeronomy, Vol. 2, 1962, pp. 687-692.

The cosmic-ray bursts occurring in the stratosphere in the high latitudes are caused by the arrival of primary cosmic rays (for the most part protons), ejected by the sun at the time of large chromospheric flares. This article discusses certain statistical data concerning the relationship between these bursts and solar chromospheric flares.

13. Charakhch'yan, A. N. and Charakhch'yan, T. N., SECULAR VARIATIONS OF COSMIC-RAY INTENSITY AND THE 11-YEAR SOLAR ACTIVITY CYCLE, Geomagnetism and Aeronomy, Vol. 6, 1966, pp. 356-361.

Data from 1957-1964 on secular variations of cosmic-ray intensity in the stratosphere are analyzed. Secular intensity variations in interplanetary space are almost exclusively governed by the 11-year solar activity. Some space and time patterns of cosmic-ray modulation in interplanetary space are found. The radius of the sphere about the sun, r, within which modulation of galactic cosmic rays occurs, depends on solar activity.

The total intensity of galactic cosmic rays near the earth ($p \geq 0.5$ Bv) reached almost 90-95% of cosmic-ray intensity outside the modulation sphere at the end of 1964. It is concluded that in a period of minimum solar activity there is no significant difference in the energy spectra of galactic cosmic rays near the earth and beyond the region of modulation.

14.   Chertoprud, V. E.,
        THE NATURE OF P_I TYPE PEAKS, Astronomicheskii Zhurnal,
        S.S.S.R., Vol. 40, 1963, pp. 48-60; Soviet Astronomy - AJ,
        Vol. 7, 1963, pp. 35-43.

        Type I bursts are correlated with P_I type bursts. The possible mechanism involved in the generation of peaks and radio bursts is considered and computed according to the scheme: stream of fast charged particles - plasma waves excited by the stream in the corona - transformation of plasma waves into electromagnetic waves - attenuation of electromagnetic waves in the corona. A qualitative estimate of the distributions of the number of P_I peaks (type I bursts) based on the proposed mechanism is made with respect to frequency of emission, intensity, position on the sun's disk, and other distributions. The results obtained are in close accord with all available data from observations of P_I type peaks and type I bursts.

15.   Chivers, H. J. A. and Hargreaves, J. K.,
        CONJUGATE OBSERVATIONS OF SOLAR PROTON EVENTS:
        DELAYED IONOSPHERIC CHANGES DURING TWILIGHT, Planetary
        and Space Science, Vol. 13, 1965, pp. 583-592.

        Solar proton events have been observed, as Polar Cap Absorption, with riometers operating simultaneously at a set of stations, some conjugate, in the northern and southern hemispheres. Comparisons of the records from stations in twilight with a station which is continuously sunlit allow an accurate determination of the changes during twilight, since changes due to the proton flux are monitored by the

sunlit station. The method also allows accurate determinations of the day-to-night ratio to be made.

It is found that after sunrise there is a time delay of several hours before the absorption reaches the full daylight value. There is also some evidence for a time delay after sunset. It appears that these results cannot be fully understood in terms of the aeronomy of the D-region as it is known at present, and it is suggested that some other photochemical process, not yet identified, might be involved.

16.   Chubb, T. A., Friedman, H. and Kreplin, R. W.,
        X-RAY EMISSION ACCOMPANYING SOLAR FLARES AND NON-
        FLARE SUNSPOT MAXIMUM CONDITIONS, Space Research Proceed-
        ings, First International Space Sciences Symposium, Nice, 1960,
        Amsterdam, North-Holland Publishing Company, 1960, pp. 695-701.

        Not abstracted.

17.   Covington, A. E.,
        SOLAR NOISE OBSERVATIONS ON 10.7 CM, I.R.E. Proceedings,
        Vol. 36, 1948, pp. 454-457.

        Daily observations of the $10 \cdot 7$-cm solar radiation show a 27-day recurrent peak which has a strong correlation with the appearance of sunspots. In the absence of large spots the equivalent temperature of the sun is $7 \cdot 9 \times 10^4 °K$. Sudden bursts of solar noise show a sharp rise lasting one or two minutes and a gradual decline to pre-storm value or to a somewhat higher value. Average burst duration is 10 min.

18.   de Jager, C.,
        THE SUN AS A SOURCE OF INTERPLANETARY GAS, Space Science
        Reviews, Vol. 1, 1963, pp. 487-521.

        The author reviews the nature of the solar sources that produce the interplanetary gas and maintain its density and distribution. The following are discussed with reference to observations: chromospheric faculae (plages), coronal condensations, active areas of the "quiet sun," flares and concomitant phenomena, different types of ratio bursts, and solar corpuscle radiation.

19.   Denisse, J. F.,
        SOLAR RADIATION IN THE ULTRA-SHORT RADIO REGION, Annales
        d'Astrophysique, Vol. 10, 1947, pp. 1-13 (In French).

Electrons of the solar atmosphere in motion in the magnetic field of a rapidly developing sunspot can give rise to electromagnetic radiation in the radio region. If this radiation is to emerge, a large variation in field strength must occur within a critical depth which is ~ 10 km for a field strength of 100 gauss in the lower corona. The lowest layers of the corona give the strongest emission and relatively little absorption. The radiation reaching the earth should be partially circularly polarized (the sense depending on the polarity of the associated spot) and should reach 10^{-17} W/cm^2 Mc/s at a wavelength of 1 m. Radiation should be observed between a few tens of cm and a few m, in good agreement with observation.

20. Dodson, H. W. and Hedeman, E. R.,
AN UNEXPECTED EFFECT IN SOLAR COSMIC RAY DATA RELATED TO 29.5 DAYS, Journal of Geophysical Research, Vol. 69, 1964, pp. 3965-3971.

Data relating to the detection of solar protons in the neighborhood of the earth (1952-1963) and to neutron counts (1958-1963) have been distributed on the basis of the mean synodic solar rotation period, 27.3 days, and the approximate synodic month, 29.5 days. In the latter, apparent departures from random distribution are especially marked. At the present time it is not clear whether the 29.5 day 'effect' is related to the sun or the moon or is only a statistical accident.

21. Dorman, L. I.,
COSMIC RAYS AND GEOMAGNETISM - A REVIEW, Geomagnetism and Aeronomy, Vol. 1, 1961, pp. 265-280.

The author presents an extensive survey of 71 research reports.

22. Dorman, L. I., Kuz'min, A. I., and Skripin, G. V.,
SOUNDING OF ELECTROMAGNETIC CONDITIONS IN THE INTER-PLANETARY MEDIUM AND IN THE VICINITY OF THE EARTH, Geomagnetism and Aeronomy, Vol. 1, 1961, pp. 298-309.

The time variations of cosmic rays of various types, such as effects during magnetic storms and solar-diurnal, 27-day, seasonal, and 11-year effects, are investigated on the basis of continuous records of the intensity of cosmic rays made at Yakutsk at the earth's surface (neutron monitor, ionization chamber, and counter telescope), as well as underground (counter telescopes in the vertical, north and south directions, at water equivalent depths of 7, 20 and 60 meters). The energy spectrum of the primary variations is determined and the

possible causes are discussed in connection with electromagnetic conditions in the vicinity of the earth, in the solar corpuscular streams, and in interplanetary space.

23. Dorman, L. I. and Kolomeyets, YE. V.,
     STATISTICAL ANALYSIS OF "SMALL" BURSTS IN COSMIC RADI-
     ATION ON QUIET DAYS DURING THE PERIOD OF MAXIMUM SOLAR
     ACTIVITY, Geomagnetism and Aeronomy, Vol. 1, 1961, pp. 579-583.

         The relationship between an increase in the intensity of cosmic
     radiation and the importance of a chromospheric flare is investigated.
     The effects are found for three groups of flares: 3 and 3+ (averages
     for 40 flares); 2 and 2+ (225 flares); 1 and 1+ (186 flares). The
     dependence of the effect on the position of the station (inside and out-
     side the zone of incidence) is examined. By contrast with a solar
     activity minimum, there is no important dependence on position dur-
     ing a period of maximum activity. This points to a diffusion-type
     propagation of solar particles during a period of maximum activity.

24. Dorman, L. I. and Kolomeyets, YE. V.,
     THE PRESENCE OF THE EFFECT OF "SMALL" COSMIC-RAY
     BURSTS ON MAGNETICALLY DISTURBED DAYS, Geomagnetism and
     Aeronomy, Vol. 2, 1962, pp. 43-44.

         The use of the method of superposing epochs for many chromo-
     spheric flares of class 2 and larger reveals that the cosmic-ray
     increase effect on magnetically disturbed days is in most cases absent
     or at least 3 or 4 times less than on quiet days. Possible reasons for
     this phenomenon are discussed.

25. Dorman, L. I. and Shatashvili, L. Kh.,
     THE 27-DAY VARIATION IN THE ANISOTROPY OF COSMIC RAYS
     REVEALED BY NEUTRON COMPONENT DATA DURING A PERIOD
     OF MAXIMUM SOLAR ACTIVITY, Geomagnetism and Aeronomy,
     Vol. 2, 1962, pp. 200-202.

         Data for several stations have been used to investigate the change
     in solar-diurnal variation in the intensity of the neutron component of
     cosmic rays associated with solar rotation. The article discusses
     possible reasons for the modulation of anisotropy of galactic cosmic
     rays.

26.   Dorman, L. I. and Kolomeyets, YE. V.,
       EFFECT OF SMALL SOLAR FLARES ON THE NEUTRON COMPO-
       NENT OF COSMIC RAYS DEPENDING ON THE TIME AND PLACE
       OF PRECEDING FLARES, Geomagnetism and Aeronomy, Vol. 2,
       1962, pp. 524-527.

       It is shown that small solar flares of intensity 1 may produce a
       slight increase in the intensity of the neutron component at the earth's
       surface if these flares occur several hours after a large chromospheric
       flare in the same active region. It is assumed that local magnetic
       traps may form in the vicinity of chromospheric flares that could be
       broken through if the density of low-energy particles is sufficient
       owing to their collective interaction with magnetized plasma of the
       solar atmosphere.

27.   Dubrovskii, V. G. and Kramarenko, S. A.,
       MORPHOLOGY OF MAGNETIC-IONOSPHERIC DISTURBANCES AS A
       FUNCTION OF SOLAR ACTIVITY AND THE NATURE OF THE COM-
       MENCEMENT OF GEOMAGNETIC STORMS, Geomagnetism and
       Aeronomy, Vol. 2, 1962, pp. 103-107.

       An analysis has been made of magnetic-ionospheric disturbances
       observed at the ionospheric stations Moscow and Ashkhabad during
       different years of the solar activity cycle 1951-1960. There have been
       found substantial differences in the nature of the effect on the iono-
       sphere of magnetic storms with sudden and gradual commencements.
       In most cases magnetic storms with sudden commencements cause a
       decrease in the critical frequencies of the F_2-layer and an increase
       in the diffuseness of the layer. Quite less frequently, magnetic storms
       with gradual commencement in the middle latitudes cause a disruption
       of the individual parameters of the F_2-layer.

       It is postulated that the decrease in critical frequencies at the
       time of geomagnetic disturbances in the middle latitudes is for the
       most part caused by the direct corpuscular effect on the upper atmo-
       sphere. Positive magnetic-ionospheric disturbances in these latitudes
       are in most cases unrelated to solar corpuscular radiation.

28.   Dvoryashin, A. S. and Levitskii, L. S.,
       CORPUSCULAR SOLAR RADIATION ON THE DECLINING BRANCH OF
       THE CYCLE OF SOLAR ACTIVITY, Izvestiya Krymsk. Astrofiz. Obs.,
       Vol. 27, 1962, pp. 167-177 (In Russian).

The authors survey first empirical and theoretical investigations of the relationship between geomagnetic disturbances and active solar areas during the descending branch of the activity cycle. The relationship is examined in detail for the time interval from February 1940 to May 1944. A close correlation is found for flocculi near the apparent solar center, and there is a phase difference of five days. The lack of such a correlation for more distant flocculi indicates the existence of radial corpuscular streams from active areas.

29.   Elliot, H.,
        THE NATURE OF SOLAR FLARES, Planetary and Space Science,
        Vol. 12, 1964, pp. 657-660.

        The energy of the sunspot magnetic field has been assumed in many models to be the source of the energy required for the optical emission from a large flare by conversion of magnetic energy into thermal energy and accelerating electrons and protons. The author proposes that energetic protons are present under quiescent conditions as trapped particles in the sunspot magnetic field in the lower corona, and that the flare is the direct consequence of the catastrophic loss of these particles in the chromosphere.

30.   Ellison, M. A.,
        ENERGY RELEASE IN SOLAR FLARES, Royal Astronomical Society,
        Quarterly Journal, Vol. 4, 1963, pp. 62-73.

        An estimate was made of the total accumulated energy in the chromospheric magnetic field, that was released in flares in the visual range. The typical field structure occurring then in H_α was explained by changes in the configuration of the magnetic fields in the flare area. Since flares repeat in the same area, it appears that the magnetic field restores itself and accumulates energy for new flares.

31.   Ellison, M. A.,
        SOLAR FLARES AND ASSOCIATED PHENOMENA, Planetary and
        Space Science, Vol. 11, 1963, pp. 597-619.

        The author presents a survey of studies of this subject, published since the beginning of the IGY.

32.   Fletcher, J. D.,
        SOLAR RADIO EMISSION AS A CRITERION FOR SOLAR PROTON
        EVENT WARNING, American Institute of Aeronautics and Astro-
        nautics, Journal, Vol. 2, 1964, pp. 2193-2197.

Specific characteristics of solar radio emission on fixed frequencies have been found to be associated with solar flares that are proton emitters. These signal characteristics are distinguishable from flares not emitting protons. Fixed frequencies between 1000 and 3750 Mc/s tend to show recognizable signal characteristics that will give a warning time from a minimum of 30 min to an average of 2 hr before the arrival of protons near the earth. The correlation between solar radio emission and solar flares and between solar flares and solar cosmic ray or proton events has been known for quite some time and has been well established. If the knowledge were available that a particular solar flare was capable of producing protons, and that, within a relatively short period of time, the protons would be observed in the vicinity of the earth, the warning time gained would be used effectively in many ways.

33. Gold, T. and Hoyle, F.,
   ON THE ORIGIN OF SOLAR FLARES, Royal Astronomical Society, Monthly Notices, Vol. 120. 1960, pp. 89-105.

   The amounts of energy liberated in flares are such that they can have been stored only in magnetic fields; the lines of force form arches over the photosphere, and are twisted; their ends are anchored in the photosphere, but the tube formed by the lines is in the chromosphere. The stored energy is liberated by annihilation of the longitudinal field components of the tubes, if two tubes of opposite polarities and twist come in contact.

34. Gopasyuk, S. I.,
   AN INVESTIGATION OF CHROMOSPHERIC FLARES AT THE INITIAL STAGE OF THEIR DEVELOPMENT, Izvestiya Krymsk. Astrofiz. Obs., Vol. 23, 1960, pp. 331-340 (In Russian).

   From H_α -cinematographs of several flares it was concluded that they might be explained as violent mass eruptions in the constricted magnetic field, similar to protuberances and filaments. A cylindrical-symmetrical form of such an eruption corresponds most closely to such flares and results in a following, rapidly propagating shock wave. Energy and temperature of flares were calculated according to this theory.

35. Gopasyuk, S. I., Ogir, M. B., and Tsap, T. T.,
   ABOUT THE RELATION BETWEEN PROCESSES IN THE PHOTO-SPHERE AND CHROMOSPHERE IN AN ACTIVE AREA DURING FLARES, Solar Data, No. 4, 1963, pp. 77-81 (In Russian).

Observations have shown that almost all flares are accompanied by ejection of material from the penumbra, and occasionally even from the umbra of the erupting spot. This indicates that the spots contribute to the formation of flares, and that the photosphere is the probable source of the material. Mass movements in the photosphere and in the chromosphere appear to be related.

36. Gregory, J. B. and Newdick, R. E.,
TWENTY-SEVEN DAY RECURRENCE OF SOLAR PROTONS, Journal of Geophysical Research, Vol. 69, 1964, pp. 2383-2385.

It has been shown that proton influx reduces the heights of partial reflection in the lower ionosphere. The solar events beginning on September 28, 1961, were used to test the periodicity. Agreement with the period of solar rotation was found for these events and also for the proton events of July 12-17, 1961 and of January 11-14, 1960.

37. Harvey, G. A.,
SOME RELATIONSHIPS BETWEEN 10.7-CM SOLAR NOISE BURSTS, FLARES, AND SHORT-WAVE FADEOUTS, Astrophysical Journal, Vol. 139, 1964, pp. 16-44.

The energetic, temporal, and longitudinal relations of flares (importance > 1), SWFs (Short Wave Fadeouts), and radio bursts at 10.7 cm during the interval from July 1957 to December 1960 were investigated on the basis of a statistical compilation. Close correlation was found between the importances of flares and SWFs and the energy of the radio bursts. The greater the energy of the radio burst, the more likely is the simultaneous appearance of SWF. The longitude distribution of flares is not related to that of radio bursts, except for maximum-energy eruptions.

38. Holt, S. S., Mendel, R. B., and Korff, S. A.,
FAST NEUTRON LATITUDE VARIATIONS IN THE ATMOSPHERE AT SOLAR MINIMUM, Journal of Geophysical Research, Vol. 71, 1966, pp. 5109-5116.

During the solar minimum conditions are particularly favorable for measurements of the neutron spectrum and flux produced by interaction of cosmic rays with the atmosphere in dependence on altitude and latitude. Results obtained between September 1964 and August 1965 with seven balloons at four points between 8 and 65 degrees of northern latitude are described.

39.   Jacobsen, C. and Carlqvist, P.,
        SOLAR FLARES CAUSED BY CIRCUIT INTERRUPTIONS, Icarus,
        Vol. 3, 1964, pp. 270-272.

        Interruptions in inductive electric current circuits in the sun are
        considered as possible causes of solar flares. The currents are
        assumed to have a filamentary structure and the interruption to be
        related to an instability well known in gas discharge physics.

40.   Jenkins, R. W. and Paghis, I.,
        CRITERIA FOR THE ASSOCIATION OF SOLAR FLARES WITH GEO-
        MAGNETIC DISTURBANCES, Canadian Journal of Physics, Vol. 41,
        1963, pp. 1056-1075.

        For the years 1949 to 1961 correlations between solar flares of
        importance $\geq 2^+$ and the beginning of geomagnetic disturbances were
        investigated. Two-hundred forty major flares were analyzed in
        regard to radio bursts of frequencies < 300 MHz, using data of ano-
        malous ionosphere disturbances. The time lag between flare and
        geomagnetic disturbance was found to be relatively constant, amount-
        ing to between 1.5 and 2 days in most cases.

41.   Krasnushkin, P. Ye.,
        INFLUENCE OF THE SOLAR WIND ON THE C-LAYER OF THE
        EARTH'S IONOSPHERE, Geomagnetism and Aeronomy, Vol. 6, 1966,
        pp. 452-453.

        This article presents an explanation of the direct correlation
        between the 11-year solar activity variations and the average annual
        intensity of the remote daytime field of extra-long radio waves propa-
        gating around the earth, largely because of an ionized layer at about
        the 50 km level of the atmosphere.

42.   Křivský, L.,
        FLARE MAXIMUM AND "SLUGGISHNESS" OF THE IONOSPHERIC
        D-REGION, Astronomical Institutes of Czechoslovakia, Bulletin,
        Vol. 13, 1962, pp. 59-62.

        From observations of 155 chromospheric eruptions the average
        time interval between the maximum of the eruption and the maximum
        reception of spurious atmospherics was determined to be 2.4 min.
        The spurious atmospherics are caused by the increase in ion concen-
        tration in the D-layer, resulting from solar x-rays. The value of 6
        to 7 min., obtained for the time interval previously by Ellison,

is discussed and the difference is explained. The new value is in good agreement with the appearance of geomagnetic phenomena also. When eruptions occur the electron density in the D-layer increases to about nine times its normal value, that is to about twice the value obtained by previous calculations.

43. Krivský, L.,
CORPUSCULAR AND PROTON CLOUD FROM FLARE AS POSSIBLE SOURCE OF RADIO EMISSION IN dm, m, DEKA-m AND km RANGE, Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 15, 1964, pp. 115-117.

For several hours after the disappearance of strong flares an increased emission in the wavelength ranges 37cm, 56cm, and 10 meters, and simultaneous strong atmospheric disturbances at $\lambda = 11$km were observed. Mechanisms for the formation are proposed, and clarification by means of artificial satellites is considered feasible.

44. Lingenfelter, R. E. and Flamm, E. J.,
NEUTRON LEAKAGE FLUX FROM INTERACTIONS OF SOLAR PROTONS IN THE ATMOSPHERE, Journal of Geophysical Research, Vol. 69, 1964, pp. 2199-2207.

In a previous calculation the equilibrium neutron distribution in the atmosphere produced by interactions of solar protons was derived by a multigroup diffusion code. These calculations are now extended to include the neutron leakage flux up to 10 Mev as a function of energy and angle. The solar proton spectrum was assumed to be of the form $dJ/dP = Ke^{-P/P_0}$. Results are presented as a function of the characteristic rigidity P_0 and of geomagnetic cutoff rigidity to facilitate comparison with experimental data. Both the calculated neutron albedo and the equilibrium flux within the atmosphere agree with available measurements within the uncertainties of the data.

45. Lingenfelter, R. E. and Flamm, E. J.,
SOLAR NEUTRONS AND THE EARTH'S RADIATION BELTS, Science, Vol. 144, 1964, pp. 292-294.

Earlier observations of protons with energies < 200MeV in the upper atmosphere and by Explorer 12 can possibly be accounted for by solar neutron emission. The existence of the neutrons could not yet be confirmed by direct observation; it is considered far more important

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for the configuration and the spectrum of the proton-Van Allen radiation belt than the galactic cosmic radiation. The required neutron spectrum was computed.

46. McCracken, K. G.,
THE COSMIC-RAY FLARE EFFECT. 1. SOME NEW METHODS OF ANALYSIS, Journal of Geophysical Research, Vol. 67, 1962, pp. 423-434.

The method consists in calculation of the asymptotic cone of incidence for the respective terrestrial location. This cone encompasses the family of directions in space from which cosmic particles of different energies can arrive when certain assumptions are made concerning the field of the earth. In this way narrowly limited incidence areas are defined so that observations by different stations make possible more accurate statements about origin and energy distribution of cosmic particles. Cones were calculated for a number of terrestrial locations.

Note: Subsequent articles (ibid.: pp. 435-446 and pp. 447-458) deal with the application of the method to flares in May and November 1960, and with the interplanetary magnetic field.

47. Michard, R., et al.,
SOME MORPHOLOGICAL AND PHOTOMETRIC PROPERTIES OF SOLAR FLARES, Observatoire de Paris, Notes Informations Publ., Fasc. 20, Astrophysique, No. 5 (In French).

A statistical study of 132 chromospheric flares between August 1956 and April 1959 shows the following: the proportion of large flares increases with the advancing development phase of the respective spot group; with an increase in magnitude of the flare the proportion of expanding flares and of flares originating simultaneously in several places increases likewise, and most flares occur above spot penumbras. Flares that extend over sunspots are more frequently accompanied by matter ejection, radio bursts in the cm-range, and ionospheric disturbances than are flares outside of sunspots. The H_α maximum brightness of a flare is only weakly correlated with its maximum area, but has a bearing on the occurrence of the accompanying phenomena mentioned before.

48. Minnis, C. M.,
IONOSPHERE, AND X-RAY IMAGES OF THE SUN, Nature, London, Vol. 208, 1965, p. 476.

The analysis of x-ray images of the sun, obtained at high altitudes, suggests that there is a darkening at the north and south poles in contrast to the luminosity of the limb. The results are compared with those deduced by the author from observations of the ionosphere during the maximum of the eclipse of 30 June 1954 (cf. Appendix A, item: Solar Eclipses and the Ionosphere).

49.   Mironovich, V.,
       THE ANNUAL COURSE OF SUNSPOTS AND OF GEOMAGNETIC
       ACTIVITY, 79th Congress of the French Association for the Advancement of Sciences, Grenoble 1960. Grenoble, Imprimerie Deux-Ponts, 1961 (In French).

       The annual course of sunspots appears significantly only from the last 11-year cycles on, and its character changes every three or four years. The annual course of geomagnetic activity is much clearer during the spot minima.

50.   Mishin, V. M., Naydenova, N. Ya., and Shukina, T. B.,
       THE ANNUAL VARIATION OF THE FREQUENCY OF OCCURRENCE
       OF MAGNETIC STORMS, Geomagnetism and Aeronomy, Vol. 2, 1962, pp. 270-273.

       This article considers the dependence on the intensity of storms and the phase of the 11-year cycle of the amplitude and phase of the first harmonics of the annual variation of the number of storms. The phase of the first harmonic experiences cyclic changes in parallel to the Wolf numbers with an amplitude of about 2π. This fact and a number of others are regarded as a result of the existence of a closed magnetic field in particle streams. The amplitude of the second harmonic of the annual variation of the number of storms increases (to 40-50 percent of the mean annual level) with a transition from moderate to large streams.

51.   Mitra, A. P., Subrahmanyam, C. V., and Karabin, M.,
       LEVEL OF SOLAR RADIO FLUX IN THE 3000MHz REGION AND ITS
       RELATION TO THE OCCURRENCE OF SUDDEN IONOSPHERIC
       DISTURBANCES, Journal of Atmospheric and Terrestrial Physics, Vol. 26, 1964, pp. 1138-1142.

       The authors investigated criteria of flares not causing SIDs. It seems that the primary criterion for the production of a SID is that the general level of microwave solar flux be above a threshold value.

During the IGY the threshold value for 3000MHz appeared to be $220 \times 10^{-22} \mathrm{Wm}^{-2} \mathrm{Hz}^{-1}$. Formation of optical flares may occur regardless of the flux being lower than the threshold value.

52.   Mitra, S. N.,
A RADIO METHOD OF DETECTING SOLAR FLARES, Journal of Atmospheric and Terrestrial Physics, Vol. 26, 1964, pp 375-398.

Because additional ionization by x-rays and Lyman-α radiation increases the reflectivity of the D-layer for long radio waves, reflection takes place at lower levels (65km), resulting in increased intensity of longwave signals from a remote station. This effect, designated SIL (Sudden Increase in Longwave Field) by the author, can be used as flare indicator, and has been found positive in 85 percent of 569 cases. The experiments were made in New Delhi on 164kHz signals from Tashkent, 1630km distant.

53.   Mitropolskaya, O. N.,
SOME RESULTS OF STATISTICAL TREATMENT OF GEOMAGNETIC DISTURBANCES OF THE DECLINING BRANCH OF SOLAR ACTIVITY, Astronomicheskii Zhurnal, S.S.S.R., Vol. 36, pp. 224-232, Soviet Astronomy-AJ, Vol. 3, 1959, pp. 228.234.

Observational material obtained during the years 1929 to 1933, 1942 to 1944, and 1951 to 1953 was used in an investigation of the relation between faculae fields on the sun and M-disturbances of the magnetic field of the earth, and a statistical correlation suitable for forecasting was derived. It was further found that the M-disturbances are as a rule caused by faculae fields that were near the center of the solar disk at the time of their passage through the central meridian.

54.   Mustel', E. R.,
STATISTICAL EFFECTS DUE TO THE CONNECTION BETWEEN PLAGES AND GEOMAGNETIC DISTURBANCES, Astronomicheskii Zhurnal, S.S.S.R., Vol. 36, 1959, pp. 215-223, Soviet Astronomy-AJ, Vol. 3, pp. 221-227.

An extensive statistical study showed that M-disturbances are primarily caused by plage (flocculi) areas that were near the apparent center of the sun at the time of transit through the central meridian. It is further shown that active areas on the sun are preferentially located in longitudinal zones separated by more than 100 degrees.

55. Neher, H. V. and Anderson, H. R.,
COSMIC RAYS AT BALLOON ALTITUDES AND THE SOLAR CYCLE,
Journal of Geophysical Research, Vol. 67, 1962, pp. 1309-1315.

Measurements of the intensity of cosmic radiation were made throughout a solar cycle (1951 to 1961) with a balloon-borne ionization chamber above Thule (88 degrees North) at heights up to 30km. Evaluation of the data showed that with increasing height the intensity of the cosmic radiation is increasingly inversely correlated with the Zürich sunspot relative numbers.

56. Neshpor, I. I.,
AN INVESTIGATION OF THE ROENTGEN-RAY EMISSION OF SOLAR FLARES BY THE RADIOASTRONOMICAL METHOD, Izvestiya Krymsk. Astrofiz. Obs., Vol. 29, 1963, 152-159 (In Russian).

Investigations of the frequency dependence of the decrease of cosmic radio emission during sudden ionospheric disturbances lead to the following conclusions:

1) The spectral intensity distribution of the Roentgen radiation of flares varies from flare to flare;

2) Some flares are distinguished by a noticeable increase of the intensity of short-wave Roentgen radiation (0.1 to 1Å).

57. Ol', A. I.,
LONG-PERIOD GIGANTIC GEOMAGNETIC FIELD PULSATIONS, Geomagnetism and Aeronomy, Vol. 3, 1963, pp. 90-95.

A special type of gigantic pulsation Pgl has been found in the magnetograms of polar observatories. The main characteristics of Pgl are their regular form, high amplitude (tens and hundreds of γ), and long period (hundreds of seconds). It was found that the period of Pgl increases with latitude. The curve for the diurnal variation of the frequency of appearance of Pgl exhibits two maxima, at 8 and 16 hours geomagnetic time. The relative intensity of the maxima depends on latitude and season. The period of the pulsations corresponding to the various maxima depends differently on latitude and the phase of the solar activity cycle. It is assumed that Pgl pulsations result from magnetohydrodynamic waves that are generated at the boundary of the exosphere. It is shown that the period of Pgl must be proportional to the square of the secant of geomagnetic latitude. This agrees with observations.

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58.   Potapova, N. I. and Shapiro, B. S.,
        N(h)-PROFILES OF THE IONOSPHERE OVER MOSCOW DURING
        THE MAGNETIC-IONOSPHERIC DISTURBANCES OF NOVEMBER 1960,
        Geomagnetism and Aeronomy, Vol. 3, 1963, pp. 48-56.

        A comparison is made between changes in the parameters of
        N(h)-profiles over Moscow during the disturbances of November 1960
        and changes in N(h)-profiles during the disturbances in July 1959. It
        is shown that the general nature of variations in the height distribution
        of ionization at middle latitudes during intense magnetic-ionospheric
        disturbances with sudden commencements remains approximately the
        same in winter and summer.

59.   Singer, S. F.,
        HIGH ENERGY RADIATION NEAR THE EARTH, Astronautica Acta,
        Vol. 10, 1964, pp. 66-80.

        The author describes the behavior of high-energy proton radiation
        in the range of the radiation belts. The particles are captured from
        the galaxy and from the sun by the neutron-albedo mechanism in the
        magnetic field of the earth. He discusses the dependence of the parti-
        cle radiation on the density of the upper atmosphere and time interval
        since the eruption of a shower of particles from the sun, and describes
        the great flare of 12 November 1960 as an example.

60.   Smith, S. F. and Ramsey, H. E.,
        THE FLARE-ASSOCIATED FILAMENT DISAPPEARANCE, Zeitschrift
        für Astrophysik, Vol. 60, 1964, pp. 1-18.

        Twenty-three flare-associated filament disappearances were
        compiled for flares of importance 2 or greater recorded between
        January 1959 and January 1963. Fourteen of these events displayed
        rapid changes in the filament within an hour prior to flare start.
        These 14 events were further analyzed for common characteristics
        in the pattern of filament changes. The common characteristics were
        combined into a seven-phase model compatible with the varied observa-
        tions of the flare-associated filament changes. The seven phases of
        filament change are described and presented with respect to: 1) times
        of occurrence before or after flare start, 2) frequency of occurrence,
        and 3) visibility as a function of the part of the H_α line profile being
        observed.

61.   Švestka, Z.,
        A PREDICTION OF PROTON FLARE OCCURRENCE IN 1966-1968,
        Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 17, 1966
        pp. 95-96.

Analysis of the 41 strong PCA occurrences between 1938 and 1955 led to a prediction of such events for the years 1966 to 1968, assuming that the 20th cycle of solar activity will not differ substantially from the preceding three. Analysis of data of all PCA events from 1957 to 1963 indicates that the total number of PCAs may be four times higher than the number of strong PCAs during the earlier period.

62.   Švestka, Z.,
        PROTON FLARES BEFORE 1956, Astronomical Institutes of Czecho-slovakia, Bulletin,Vol. 17, 1966, pp. 262-270.

        From the results of vertical soundings at high-latitude stations before 1956 47 occurrences between 1938 and 1955 were very probably PCAs; observed or presumptive flares account for 32 occurrences. The rarity of PCAs during the northern winter, and the North-South asymmetry of proton flares have been confirmed. PCAs are predicted for 1966 and 1967.

63.   Vette, J. I. and Casal, F. G.,
        HIGH-ENERGY X-RAYS DURING SOLAR FLARES, Physical Review Letters, Vol. 6, 1961, pp. 334-336.

        The detector was a balloon-borne NaI scintillation counter, flown to 120,000 ft, and pointed at the sun. Two solar flares, one class 2 and the other class 1, as well as radio disturbances, occurred during a flight on Oct. 12, 1960. X-rays were detected in three energy classes, > 20 keV, > 80 keV, and > 150 keV. For the class 1 flare, a differential X-ray energy spectrum is calculated as a power law with exponent -1.6. Assuming production to be caused by electron bremsstrahlung in the solar chromosphere, and using the decay time for the X-ray burst of about 100 sec, the depth of production in the chromosphere is estimated. The peak intensity of the class 1 flare event at the top of the atmosphere is estimated at 1.2×10^{-6} erg cm^{-2} sec^{-1}, and that for the class 2 event about twice as much.

64.   Wentzel, D. G.,
        FORMATION OF SOLAR FLARES WITHOUT MAGNETIC NEUTRAL POINTS, Astronomical Journal, Vol. 69, 1964, pp. 151-152.

        This is an abstract of a paper presented at the 115th Meeting of the American Astronomical Society, held 26-28 December 1963 at Georgetown University, Washington, D. C. See following item.

65.   Wentzel, D. G.,
        SOLAR FLARES CAUSED BY THE SKIN EFFECT IN TWISTED
        MAGNETIC FIELDS, Astrophysical Journal, Vol. 140, 1964,
        pp. 1563-1578.

        The formation of chromospheric flares is explained as caused by
        the intrusion of an unstable chromospheric domain into an area of
        very small but non-zero magnetic field strength under the influence
        of magnetic forces. This theory yields reasonable values for the time
        required for development of flares. The postulated process need not
        lead to the formation of flares; if it occurs too high in the chromo-
        sphere, radio bursts, x-ray, or particle emission may follow instead
        of flare formation.

66.   Wilson, B. G. and Nehra, C. P.,
        A STATISTICAL ANALYSIS OF COSMIC-RAY INTENSITY CHANGES
        ASSOCIATED WITH SOLAR FLARES, Journal of Geophysical
        Research, Vol. 67, 1962. pp. 3707-3716.

        Simultaneous measurements of the cosmic radiation following
        solar eruptions were made in 1959 to 1960 at Sulphur Mountain
        ($\varphi_{magn} = +58°$, h = 2283m) and at Resolute ($\varphi_{magn} = +83°$, h = 0m).
        The neutron component increased by 0.3 percent at the mountain
        station, but only rarely at sea level when the eruptions affected the
        ionosphere. It was found further, that the maximum of the cosmic
        radiation arrives about four hours after the eruption; this may be
        explained as a storage effect for high-energy particles (< 400MeV)
        at times of strong solar activity.

67.   Yilmaz, F.,
        THE CHANGE OF FACULA AREAS IN SOLAR ACTIVITY CENTERS,
        Istanbul University Observatory, Publications, No. 78, 1964 (In
        German).

        The progress of chromospheric H and Ca^+ facula areas was
        examined in relation to the activity of spot groups after the maximum
        phase of the activity centers. A rapid decrease of the spot activity
        engenders expansion of the facula domains; however, a gradual dimi-
        nution of the spot activity causes a contraction of these domains.
        Further, diminution of the spot activity causes a displacement of
        the Ca^+-facula domain toward the West, relative to the H_α-facula
        domain.

68.   Zolotov, I. G.,
       WESTWARD DRIFT OF THE NONDIPOLE GEOMAGNETIC FIELD AND
       SOLAR ACTIVITY, Geomagnetism and Aeronomy, Vol. 6, 1966,
       pp. 742-744.

       Gaussian coefficients for this epoch both for the geomagnetic field
       and for its secular variations were determined using earlier spherical
       analyses of $\dot{V}$ and of V coefficients. Taking into account the length
       of the different periods, the correlation between drift velocities for
       neighboring epochs and the 11-year solar cycle appears satisfactory;
       an objective estimation of the degree of correlation yields with a prob-
       ability of 90 percent a negative correlation between the westward drift
       velocity of the nondipole part of the geomagnetic field and solar activ-
       ity. A relationship may exist between these and the angular velocity
       of rotation of the earth.

69.   Zosimovich, I. D.,
       SOME RESULTS OF A STUDY OF THE CORPUSCULAR FIELD OF
       THE SUN FROM GEOMAGNETIC DATA, Geofizika i Astronomiya,
       Ukrain. S. S. R., No. 8, 1965, pp. 9-12 (In Russian).

       Examination of 2688 values of coefficients of the correlation
       between geomagnetic data of the period from 1890 to 1958 and the
       corpuscular field of the sun show that the structure of this field is
       stable. A distinct correlation was found between the correlation
       coefficient and the heliographic latitude of the earth. The variations
       of the corpuscular streams near the plane of the ecliptic can be studied
       by this procedure.

See also:

Section I, items 5, 14, 15, 50, 83, 85, 88, 92, 95, 105, 107, 115, 143, 146,
150, 161, 174, 198, 206, 208, 209, 215, 223, 224, 244, 245, 247, 251, 261,
262.

Section II, items 4, 5, 6, 7, 8, 10, 12, 13, 14, 15, 17, 21, 27, 29, 33, 38, 39,
41, 43, 44, 46, 47, 48, 49, 53, 54, 55, 62, 63, 64, 65, 68, 69, 71, 72, 73,
74, 78, 79, 82, 88, 92, 93, 94, 97, 98, 99, 100, 104, 107, 113, 117, 121, 123,
131, 132, 133, 135.

Section IV, items 6, 8, 10, 11, 14, 15, 16, 17, 18, 20, 23, 24, 25, 26, 28, 33,
34, 35.

Section IV. SUPPLEMENT AND MISCELLANY

1. Al'pert, Ya, L., Gurevich, A. V., and Pitaevskii, L. P.,
    EFFECTS DUE TO AN ARTIFICIAL EARTH SATELLITE IN RAPID
    MOTION THROUGH THE IONOSPHERE OR THE INTERPLANETARY
    MEDIUM, Space Science Reviews, Vol. 2, 1963, pp. 680-748.

    In the vicinity of the satellite or space probe occur interactions
    with the particles of the surrounding medium, which cause temporary
    changes of their physical parameters. These changes are discussed
    at length, since they must be known if the nature of the unperturbed
    medium is to be determined by measurements with on-board
    equipment.

2. Andrenko, L.,
    STATISTICS OF COMETS VISIBLE TO THE UNAIDED EYE THROUGH
    THE CENTURIES, Gazette Astronomique, Vol. 20, 1933, pp. 90-91
    (In French).

    Not abstracted.

3. Baidal, M. Kh.,
    DROUGHT AND SOLAR ACTIVITY, Kazakh. Hydrometeorological
    Institute, Publications, No. 20, 1963, pp. 87-89 (In Russian).

    The author examined the frequency of droughts in the northern
    part of the Kazakh S.S.R. for a relation with the cycles of solar
    activity. He established that precipitation in this area was from 20
    to 30 percent greater than normal during the descending branch of
    the 80- to 90-year cycle, that is from 1888 to 1918. In the years of
    the maximum of an 11-year cycle there is about 10 percent more
    precipitation in this area during the months from June to August,
    than during the minimum years. Droughts occurred either in the
    years of the minimum of the 11-year cycle, or in the two years pre-
    ceding them.

    Note: A more comprehensive review may be found in Referativnii
    Zhurnal, S.S.S.R., 1964, 2.51.463.

4. Baktai, M., Feyesh, I., and Horvat, A.,
    REFLECTION OF SOLAR ACTIVITY IN THE BEHAVIOR OF THE
    ANNUAL RINGS OF "PINUS TARNOCIENZICA" OF THE MIOCENE

PERIOD, <u>Astronomicheskii Zhurnal</u>, S.S.S.R., Vol. 41, 1964, pp. 413-414; <u>Soviet - Astronomy - AJ</u>, Vol. 8, 1964, pp. 322-323.

The widths of the rings varied with a period of about seven years. Apparently the period of solar activity during the Miocene period was shorter.

5. Bushko, R. P.,
COMETS AND SOLAR ACTIVITY, <u>Solar Data</u>, No. 7, 1963, pp. 71-75 (In Russian).

It was found that the brightness of comets increases in the years of least ultraviolet radiation from the sun. From this a connection between cometary brightness and solar corpuscular radiation might be inferred.

6. Caroubalos, C. and Martres, M.-J.,
A MORPHOLOGICAL PROPERTY OF SUNSPOT GROUPS RESPON-SIBLE FOR ERUPTIONS ACCOMPANIED BY METRE WAVELENGTH RADIATION, <u>Acad. Sci., Comptes Rendus</u>, Vol. 258. 1964, pp. 830-832 (In French).

A geometrical parameter characterizing sunspot groups is defined. It is shown that eruptions accompanied by metre-wavelength radiation and emission of high energy particles are characterized by small values of this parameter.

7. Dobrovolskii, O. V.,
COMETS AS INDICATORS OF SOLAR ACTIVITY, <u>Franko State University, Lvov, Astronomical Monographs</u>, No. 3-4 (In Russian).

Not abstracted.

8. Fehlhaber, L.,
THE INFLUENCE OF EXTRATERRESTRIAL CORPUSCULAR CURRENTS ON THE MAGNETIC FIELD OF THE EARTH, <u>Zeitschrift für Geophysik</u>, Vol. 29, 1963, pp. 65-80 (In German).

An interaction exists between plasma currents in interplanetary space and the magnetic field of the earth. The conditions under which this interaction may result in feedback, that is in an increase of the magnetic moment of the earth, are examined.

9.   Fel'dshteyn, Ya. I.,
CHANGES IN THE POSITION OF THE AURORAL ZONE IN RELATION
TO THE SOLAR ACTIVITY CYCLE, <u>Geomagnetism and Aeronomy</u>,
Vol. 2, 1962, pp. 476-478.

     The poleward shift of the zone in years of minimum solar activity
is too small to account for the increased frequency of auroras. Other
explanations are discussed.

10.   Gnevyshev, M. N. and Ol', A. I.,
CORONAL EMISSION LINE INTENSITY AS AN INDEX OF SOLAR
CORPUSCULAR RADIATION, <u>Astronomicheskii Zhurnal</u>, S.S.S.R.,
Vol. 42, 1965, pp. 992-995; <u>Soviet Astronomy - AJ</u>, Vol. 9, 1965,
pp. 765-767.

     It is demonstrated that the mean annual values of geomagnetic
disturbance (A_p) are related to the intensity of the coronal line
λ 5303 Å more closely than to any other index of solar activity. The
conclusion is drawn, therefore, that coronal intensity can be used as
an index of solar corpuscular radiation.

11.   Hachenberg, O. and Krüger, A.,
RESEARCH ON THE CONTINUOUS SPECTRUM OF SOLAR RADIO
EMISSION BURSTS IN THE LOW dm- AND IN THE cm-WAVE RANGES,
<u>Zeitschrift für Astrophysik</u>, Vol. 59, 1964, pp. 261-275 (In German).

     The main features of burst spectra found in this investigation are
1. flux densities increasing monotonously towards higher frequencies
and 2. broad emission bands with maxima at various frequencies.
Spectra of the first kind are thought to be generated by thermal radi-
ation. Spectra of the second kind can be explained by a synchrotron
mechanism like type IV-bursts. In many cases a combination between
these two mechanisms is required.

12.   Ho, Peng Yoke (Ho, Ping Yü),
ANCIENT AND MEDIEVAL OBSERVATIONS OF COMETS AND NOVAE
IN CHINESE SOURCES, <u>Vistas in Astronomy</u>, England, Vol. 5, 1962,
pp. 127-225.

     The errors present in certain catalogs are discussed, and the
principal sources are critically reviewed. Documents relating to
nearly 600 observations of comets and novae are translated with the
addition of comments, and wherever possible comparisons are made
with Korean and Japanese observations.

13. Iroshnikov, R. S.,
      OSCILLATORY INSTABILITY OF THE GAS IN THE VICINITY OF
      THE LOWER BOUNDARY OF THE SOLAR CONVECTIVE ZONE,
      Astronomicheskii Zhurnal, S.S.S.R., Vol. 42, 1965, pp. 259-266;
      Soviet Astronomy - AJ, Vol. 9, 1965, pp. 202-207.

      A possible oscillatory instability of the gas in the region sur-
      rounding the surface of maximum unperturbed entropy is considered.
      Dissipation is governed by radiative and convective thermal conductiv-
      ity. It is shown that the equations and boundary conditions admit an
      oscillatory unstable solution when negative dissipation in the convec-
      tive layers predominates over positive dissipation in nonconvective
      layers and the Archimedean force in the nonconvective zone being
      larger than that in the convective zone is responsible for the oscilla-
      tory state. Calculations show that the slowest oscillations of this
      type for the sun have a period of the order of one month and, appar-
      ently, are of no interest for the interpretation of the solar activity
      cycle.

14. Kislyakov, A. G. and Salomonovich, A. E.,
      RADIO EMISSION FROM SOLAR ACTIVE REGIONS IN THE MILLI-
      METER REGION, Astronomicheskii Zhurnal, S.S.S.R., Vol. 40,
      1963, pp. 229-234; Soviet Astronomy - AJ, Vol. 7, 1963,
      pp. 177-181.

      Results are given of observations of radio emission from solar
      localized sources, made simultaneously on 4 and 8 mm with the 22-m
      radio telescope of the FIAN. The dimensions and brightness temper-
      atures of two sources, identified with (sun) spot groups are deter-
      mined. The data obtained are not in contradiction with the hypothesis
      that radio emission from active regions is thermal radiation emitted
      by coronal condensations that are optically thin in the millimeter
      region. Active regions identified with plages are also noted.

15. Kovner, M. S. and Chertok, I. M.,
      COHERENT ČERENKOV AND SYNCHROTRON INSTABILITIES OF
      SOLAR CORPUSCULAR STREAMS, Geomagnetism and Aeronomy,
      Vol. 3, 1963, pp. 817-821.

      It is shown that due to the existence of Landau absorption in the
      interplanetary medium the weak streams penetrating through plasma
      can be stable. The critical concentration of the stream $(N_s)_{cr}$,
      above which a stream becomes unstable in the space between the sun

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and earth, and the radiation frequency are dependent on the velocity of the stream. For example, streams with $v > 10^8$ cm/sec and $N_S \geq 10$ cm^{-3} generate plasma waves in the range of frequencies 400-100 kc/s. The presence of absorption also makes it impossible for the stream to radiate ordinary and extraordinary waves.

16.   Kreuzer, G.,
ON THE RELATION BETWEEN ROENTGEN RADIATION BURSTS IN THE POLAR AURORA ZONE AND BAY-TYPE EARTHMAGNETIC DISTURBANCES, Naturwissenschaften, Vol. 50, 1963, pp. 661-662 (In German).

The Roentgen radiation is the result of bremsstrahlung of electrons entering the atmosphere. These electrons are accelerated in the magnetosphere by a process, the mechanism of which is still unknown. The interaction with the magnetic field and the relation with its fluctuations are examined.

17.   Lüst, R.,
ACTIVITY OF COMETS' TAILS DURING PERIODS OF GEOMAGNETIC INACTIVITY, Zeitschrift für Astrophysik, Vol. 51, 1961, pp. 163-176 (In German).

If interplanetary matter is identical with the particle stream emitted by the sun, as has been assumed recently, there must be a continuous particle emission even in times of low solar activity. Four comets have been found which possess ionized tails showing rapid and continuous changes of structure during extended periods of extremely low geomagnetic activity, thus supporting the aforementioned assumption. These four comets are discussed in detail. An example of a very strong correlation between tail activity and geomagnetic storms is given. The time lag between the geomagnetic disturbance and the event on the comet indicates a velocity of the solar particle stream of about 300-400 km/sec, which is lower than the velocity observed during periods of enhanced solar activity (about 1000 km/sec).

18.   Lüst, R.,
OBSERVATIONS OF THE COMET ABELL 1953g IN RELATION WITH THE SOLAR WIND, Zeitschrift für Astrophysik, Vol. 57, 1963, pp. 192-196 (In German).

Observations of Comet Abell 1953g showed, that this comet possessed an active ionized gas tail during a period of extremely low geomagnetic activity in 1954, the year of the last sunspot minimum.

These observations are discussed as further evidence for the continuous outflow of protons and electrons from the sun, the so-called solar wind.

19. Makarov, V. I.,
    SOME PROBLEMS IN THE THEORY OF SUNSPOTS, Izvestiya Astr. Glavn. Obs., Pulkovo, Vol. 23, 1960, pp. 40-48 (In Russian).

    The following points are discussed:

    1) The smallest size of a pore from which a sunspot may form,

    2) The dependence of the magnetic field strength in a sunspot on the spot area,

    3) The depth of the umbra in the photosphere,

    4) The energy of the magnetic field in the interior of a sunspot.

20. Mandrykina, T. L.,
    THE INDICES ΣS_{max}, $\bar{S}$, and $\bar{S}_M$ DURING THE PRESENT CYCLE, Lvov University, Astr, Obs., Tsirkulyar, No. 41, 1964, pp. 31-34 (In Russian).

    Not abstracted.

21. Milošević, K.,
    DETERMINATION OF THE ROTATIONAL VELOCITY OF THE SUN AT THE (SUNSPOT) MAXIMUM OF 1948, Acad. Sci., Comptes Rendus, Vol. 241, 1955, pp. 590-592 (In French).

    Measurements of the position on the solar disk of small chromospheric faculae during the sunspot max. period, 1947-8, when compared with corresponding data for the min. period, 1953-4, indicate that the angular valocity of solar rotation has remained constant during this half-cycle. This result is at variance with the conclusions of U. Becker (1954) and E. Schodo (1951), but agrees with the results of H. W. Newton and M. L. Nunn (1951).

22. Mosetti, F.,
    ON TEMPORARY FLUCTUATIONS OF SOME NATURAL PHENOMENA, Bolletino di geofisica teorica ed applicata, Trieste, Vol. 8, 1966, pp. 62-76.

The divers components of solar activity appear again in terrestrial phenomena; however, they have then different phases and amplitudes. For example the 30-year cycle is the most important where the motion of glaciers is concerned.

23. Mouradian, Z.,
ON THE PHOTOMETRY OF ERUPTIVE FACULAE ASSOCIATED WITH SUDDEN DISAPPEARANCES OF SOLAR FILAMENTS, Acad. Sci., Comptes Rendus, Vol. 250, 1960, pp. 978-980 (In French).

Fourteen eruptive faculae were examined photometrically; two types of brightness curves were found. One of them corresponds to facula fluctuations, the other to the behavior of normal eruptions. The latter appears usually only when the filament is still connected to spot groups, the former if the filament has no spot group connection (old filament). No ionospheric disturbances accompanied any of these events.

24. Nikol'skii, G. M.,
SOLAR SHORT-WAVE RADIATION: REVIEW, Geomagnetism and Aeronomy, Vol. 2, 1962, pp. 1-27

The author reviewed 85 reports on research in the ultraviolet and x-ray spectrum of the sun during the years 1946 to 1960. Numerous charts and tables are reproduced.

Note: For a study of the solar radiation flux in the region $\lambda <$ 1100 Å, see: Nikol'skii, G. M., Geomagnetism and Aeronomy, Vol. 3, 1963, pp. 643-649.

25. Parker, E. N.,
THE SOLAR-FLARE PHENOMENON AND THE THEORY OF RECONNECTION AND ANNIHILATION OF MAGNETIC FIELDS, Astrophysical Journal, Supplement 8, pp. 177-211.

The theory of the annihilation of magnetic fields is treated quantitatively, and it is shown that, contrary to earlier assumptions, all known mechanisms furnish such a small energy flux that it cannot cover the energy requirement of a flare. This is corroborated by observations. Other possibilities are reviewed.

26.   Piccardi, G.,
        ON SOME ANOMALIES OBSERVED DURING THE MAXIMUM OF
        SOLAR ACTIVITY, Geofisica e Meteorologia, Vol. 13, 1964,
        pp. 65-66 (In Italian).

        During 1958, the period of maximum solar activity, no anomaly
        of the chemical tests F, D, and P were observed. Conversely,
        anomalies were noted in the biological tests. Moreover, a study of
        the numerical indices of several solar phenomena (Ca and H faculae,
        filaments) and of the characteristic geomagnetic number C_p shows

        anomalies of these indices during the same period.

27.   Piccardi, G.,
        INTENSITY OF SOLAR CORONA, WOLF NUMBER, BIOLOGICAL
        AND CHEMICAL TESTS, Geofisica e Meteorologia, Vol. 14, 1965,
        pp. 77-78.

        R, the Wolf number, and C, the intensity of the solar corona,
        vary in the same manner for groups of small values of R, but it is not
        so for sufficiently high values of R. The results of chemical and
        biological tests vary as the intensity of the corona.

28.   Pikel'ner, S. B. and Gintzburg, M. A.,
        THE MECHANISM OF TYPE II BURSTS OF SOLAR RADIO EMISSION,
        Astronomicheskii Zhurnal, S. S. S. R., Vol. 40, 1963, pp. 842-846;
        Soviet Astronomy - AJ, Vol. 7, 1963, pp. 639-642.

        Type II bursts are formed by plasma waves. The generation of
        plasma waves is possible only if the drift velocity of electrons is
        greater than the thermal velocity. This condition is not fulfilled for a
        regular corpuscular stream. However, it can be fulfilled for drift
        motion of electrons in a collisionless shock-wave front. Estimates
        show that in this case radio emission with an intensity of the order of
        that observed can originate. Similar emission is generated in a shock
        wave due to motion of the stream relative to the earth. The plasma
        waves formed can accelerate the particles of the radiation belts.

29.   Sekanina, Z.,
        SOLAR ACTIVITY AS RELATED TO THE STATISTICS OF COMETS,
        Astronomical Institutes of Czechoslovakia, Bulletin, Vol. 10, 1959,
        pp. 103-104.

A study was made of the dependence on the sunspot cycle phase of 563 comets discovered between 1610 and 1954. The number (N) of discovered comets, the bigness (τ) of the cometary tails, the mean heliocentric distances (Γ) of the comets at the time of their discovery, the corresponding geocentric distances (Δ), the mean absolute brightness (H) at the time of perihelion, and the mean (m) apparent brightness at the time of discovery were related to the activity of the sun. The correlations for Γ, Δ, and H were unambiguous, while m was found to be constant within the limits of accuracy. An explanation is given for two minima that were found for N and τ.

30.   Sekanina, Z.,
        CHANGES OF COMETARY CHARACTERISTICS AS RELATED TO THE
        CHANGES OF SOLAR ACTIVITY, Astronomical Institutes of Czecho-
        slovakia, Bulletin, Vol. 11, 1960, pp. 94-110.

        Eleven characteristic parameters of 563 comets occurring
        between 1610 and 1954 were examined for their phase dependence in
        the activity cycle of the sun. The parameters were divided into two
        classes, I and II. The distribution functions of class I show a double
        wave (period: 5.5 years), those of class II show a simple wave
        (period: 11 years). This can probably be accounted for by the fact
        that only the parameters of class II are direct indicators of solar
        activity, while meteorological conditions are decisive for the others.

31.   Sekanina, Z.,
        VARIATION OF THE AVERAGE ABSOLUTE BRIGHTNESS OF
        COMETS DURING AN ELEVEN-YEAR SOLAR CYCLE, Astronomical
        Institutes of Czechoslovakia, Bulletin, Vol. 11, 1960, pp. 222-226.

        A physical interpretation is given for the shape of the curve
        showing the mean absolute brightness as a function of time. This
        curve represents the so-called cometary characteristics of class II.
        The fundamental relations affecting the shape of the curve are
        described, the general equation for the energy balance of the mole-
        cular, cometary radiation is derived, and special cases are discussed.
        The trend of the variation of the absolute brightness of comets during
        a solar cycle indicates that the change of the average lifetime of the
        radiating molecule in the cometary atmosphere is the prime reason
        for the variation of the brightness of comets; special assumptions
        make it possible to determine the variation of the exciting radiation.

32.   Sekanina, Z.,
        THE SECULAR DECREASE OF THE ABSOLUTE MAGNITUDE OF
        SHORT-PERIOD COMETS, Acta Universitatis Carolinae (Math.)
        Prague, No. 1, 1960, pp. 13-25, Prague University Astronomical
        Institute, Publications, No. 28.

By taking nine comets as examples, it is shown that the absolute brightness of comets decreases according to $m_0(t) = \alpha \times 10^{\beta t}$. The relation $\alpha = 0.53 - 0.52 \log \alpha$ between α and the disintegration constant β is valid, with little scattering for all comets. Differences between observed and calculated brightness of comet Encke, which is especially useful for studies of this type because of its short period, in the interval from 1820 to 1950, appear to be correlated with solar activity.

33.   Stepanyan, A. A.,
        ON THE WIDTH OF CORPUSCULAR STREAMS RESPONSIBLE FOR
        THE DIURNAL EFFECT IN COSMIC RAYS, Izvestiya Krymsk.
        Astrofiz. Obs., Vol. 29, 1963, pp. 126-130 (In Russian).

The amplitude dependence of the diurnal fluctuation of the cosmic radiation is explained as a function of the angle of incidence with the plane of the ecliptic, assuming a large angular spread of the corpuscular streams in the meridional plane of the sun.

34.   Vinogradov, Yu. I.,
        IONOSPHERIC EFFECTS OF PROTON AND NON-PROTON FLARES
        FROM OBSERVATIONS AT THE IONOSPHERIC STATION OF THE
        CRIMEAN ASTROPHYSICAL OBSERVATORY, Izvestiya Krymsk.
        Astrofiz. Obs., Vol. 32, 1964, pp. 67-75 (In Russian).

Not abstracted.

35.   Zheleznyakov, V. V.,
        THE FREQUENCY SPECTRUM OF THE SLOWLY VARYING COMPO-
        NENT OF SOLAR RADIO EMISSION, Astronomicheskii Zhurnal,
        S.S.S.R., Vol. 40. 1963, pp. 829-841; Soviet Astronomy - AJ,
        Vol. 7, 1963, pp. 630-638.

Radio emission at millimeter wavelengths and the short-wave side of the centimeter range above flocculi with $T_{eff} \ll 10^6$ K is apparently of bremsstrahlung origin with intensity independent of the wavelength. In the region of wavelengths $\lambda > 3$ cm, and especially

near the intensity maximum ($\lambda \sim$ 5-8 cm) , the synchrotron radiation of electrons moving in the magnetic field of sunspots in layers with frequencies $\omega \simeq 2 \omega_H$, $3 \omega_H$ (ω_H – gyrofrequency) becomes very

important. It is possible that synchrotron radiation plays an appreciable rôle at the beginning of the decimeter region. More definite conclusions on the relative contribution of bremsstrahlung and synchrotron radiation in this wavelength interval to the s-component can be made only after precise measurements of the intensity of the s-component have been made in the millimeter region, as the latter in fact determines the level of bremsstrahlung also at longer wavelengths.
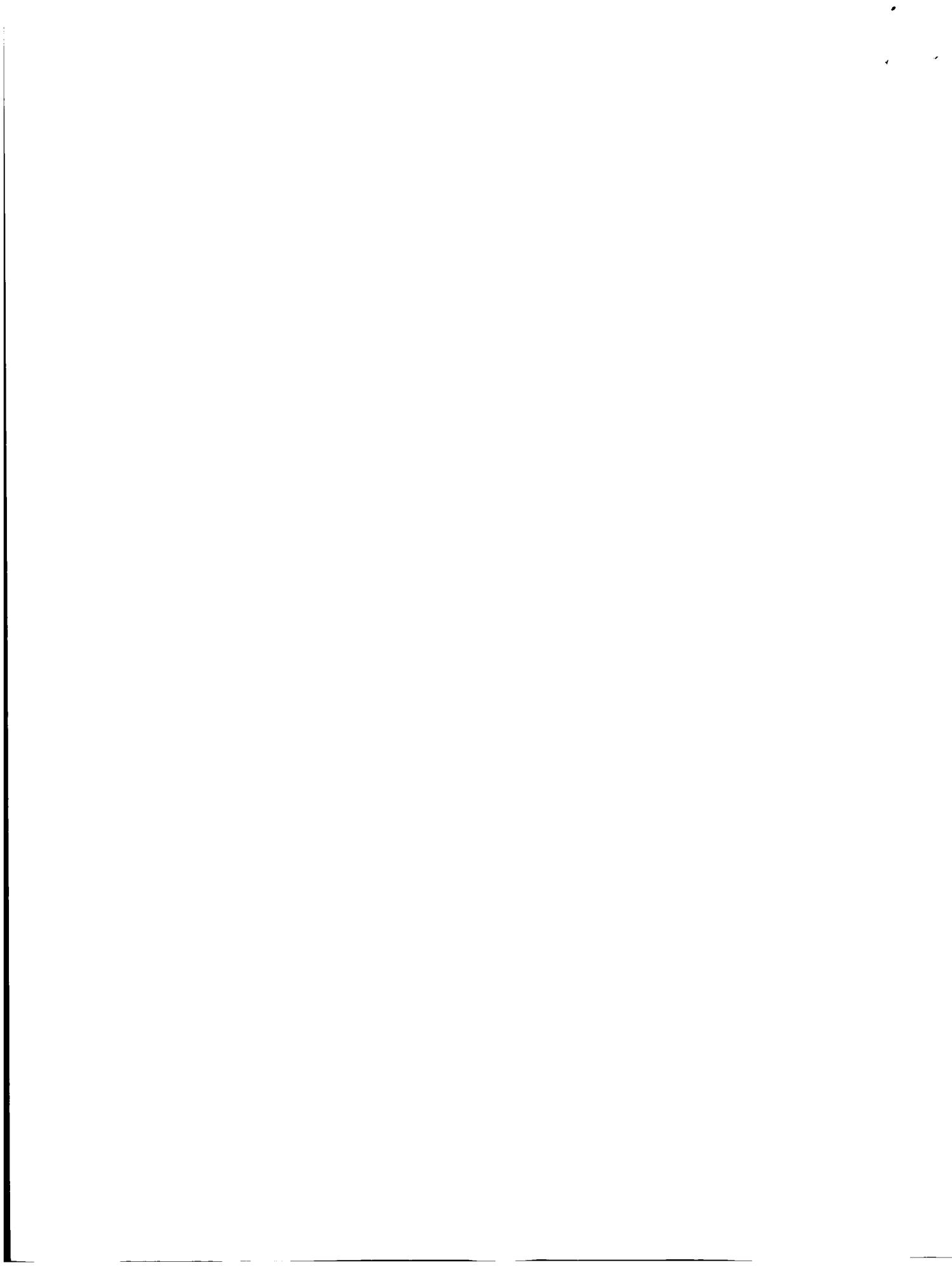
Appendix. A. BOOKS

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   Kondrat'yev, K. Ya.
   Gidrometeorologicheskoe Izdatel'stvo, Leningrad, 1965.
   Translated for the National Aeronautics and Space Administration,
   Washington, D. C., NASA TT F-9712, 1965 (QC911 K82).

2. ASTROPHYSIK III. DAS SONNENSYSTEM (ASTROPHYSICS III. THE
      SOLAR SYSTEM)
   Vol. 52, Handbuch der Physik
   Flügge, Siegfried, ed.
   Springer Verlag, Berlin, Göttingen, Heidelberg, 1959 (QC21 H236).

3. CATALOGUE GÉNÉRAL DES ORBITES DE COMETES DE L'AN -466 À
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      TO 1952)
   Baldet, Ferdinand et de Obladia, Giselle
   Centre National de Recherche Scientifique, Paris, 1952 (QB357 B176).

4. ELECTROMAGNETIC PHENOMENA IN COSMICAL PHYSICS
   Lehnert, B., ed.
   Proceedings of IAU Symposium No. 6, Held in Stockholm, August 1956.
   The University Press, Cambridge, England, 1958 (QB461 L523).

5. DIE HÄUKFIGKEIT DER SONNENFLECKEN (THE FREQUENCY OF
      SUNSPOTS)
   Gleissberg, Wolfgang
   Akademie Verlag, Berlin, 1952 (QB525 G557).

6. INTERNATIONAL CONFERENCE ON COSMIC RAYS
   Daniel, R.R. et al., editors
   Proceedings of the International Conference on Cosmic Rays, Held at
      Jaipur, 1963.
   Government of India, 1963- . (QC485 I61).

7. INTRODUCTION TO SOLAR TERRESTRIAL RELATIONS
   Ortner, J. and Maseland, H., editors
   Proceedings of the Summer School in Space Physics, Alpbach, Austria,
      15 July - 10 August 1963.
   Gordon and Breach, New York, 1965 (QC801 S955).

8. OUR SUN
    Menzel, Donald H.
    Harvard University Press, Cambridge, Mass., 1959 (QB521 M551).

9. PHYSICAL CHARACTERISTICS OF COMETS (FIZICHEKIE
        KHARAKTERISTIKI KOMET)
    Vsekhsvyatskii, S. K.
    Gosudarstvennoe Izdatel'stvo, Moskva, 1958
    Published for the National Aeronautics and Space Administration and
        the National Science Foundation, Washington, D. C.
    Israel Program for Scientific Translations, Jerusalem, 1964
        (QB721 V985).

10. PHYSICS OF THE SOLAR SYSTEM (KURS ASTROFIZIKI I ZVEZDNOI
        ASTRONOMII, TOM 3)
    Mikhailov, A.A., et al., editors
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11. PROBLEMS OF SOLAR ACTIVITY
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    Izdatel'stvo "Nauka," Moskva-Leningrad, 1964
    Translated for the National Aeronautics and Space Administration,
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12. RADIOASTRONÓMIA SOLARE (SOLAR RADIO ASTRONOMY)
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    Rendiconti della Scuola Internacionale di Fisica "Enrico Fermi,"
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13. SOLAR ACTIVITY FORECASTING
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14. SOLAR ACTIVITY MAPS
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15. THE SOLAR CORONA
     Evans, J.W., ed.
     Proceedings of IAU Symposium No. 16, Held at Cloudcroft, New Mexico,
         28-30 August 1961
     Academic Press, New York and London, 1963 (QB529 I61).

16. SOLAR ECLIPSES AND THE IONOSPHERE
     Beynon, W.J.G. and Brown, G.M., editors
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     Pergamon Press, London and New York, 1956 (883 I61).

17. SOLAR FLARES
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     The Macmillan Company, New York, 1963 (QB528 S649).

18. SOLAR RADIO ASTRONOMY
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     The Macmillan Company, New York, 1963 (QB521 A147).

20. SOLAR SYSTEM ASTROPHYSICS
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     McGraw-Hill Book Company, Inc., New York, 1964 (QB501 B821).

21. SOLAR SYSTEM RADIO ASTRONOMY
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         National Observatory of Athens, Cape Sounion, 2-15 August 1963
     Plenum Press, New York, 1965 (QB501 A244).

22. DIE SOMMERNIEDERSCHLAGE MITTELEUROPAS IN DEN LETZTEN
$1\frac{1}{2}$ JAHRHUNDERTEN UND IHRE BEZIEHUNGEN ZUM
SONNENFLECKENZYKLUS (SUMMER PRECIPITATION IN CENTRAL
EUROPE DURING THE PAST $1\frac{1}{2}$ CENTURIES, AND ITS RELATION
TO THE SUNSPOT CYCLE)
Baur, Franz
Geest and Portig, Leipzig, 1959 (QC883 B351).

23. SPACE EXPLORATION AND THE SOLAR SYSTEM
Rossi, B., ed.
Proceedings of the International School of Physics "Enrico Fermi,"
Varenna on Lake Como, 4-16 June 1962
Academic Press, New York and London, 1964 (QB501 V295).

24. A STAR CALLED THE SUN
Gamow, George
The Viking Press, New York, 1964 (QB521 G194).

25. STELLAR AND SOLAR MAGNETIC FIELDS
Lüst, R., ed.
Proceedings of IAU Symposium No. 22, Held in Rottach-Egern near
Munich, Germany, 3-10 September 1963
North Holland Publishing Company, Amsterdam, and John Wiley and Sons,
New York, 1965 (QC809.M25 L948).

26. THE SUN
Abetti, Giorgio
Faber and Faber, London, 1963 (QB521 A147).

27. THE SUN
Kiepenheuer, K.O.
The University of Michigan Press, Ann Arbor, 1959 (QB521 K47).

28. THE SUN
Vol. 1 of THE SOLAR SYSTEM
Kuiper, Gerard P., ed.
The University of Chicago Press, Chicago and London, 1953
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29. THE SUN AND ITS INFLUENCE
Ellison, M.A.
Routledge and Keegan Paul Ltd., London, 1959 (QB531 E47).

30.   THE SUNSPOT ACTIVITY IN THE YEARS 1610-1960
       Waldmeier, M.
       Schulthess u. Co., AG, Zürich, 1961 (QB525 W164).

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         GREENWICH OBSERVATIONS 1874-1954
       Royal Greenwich Observatory
       Her Majesty's Stationery Office, 1955 (QC836 H966).

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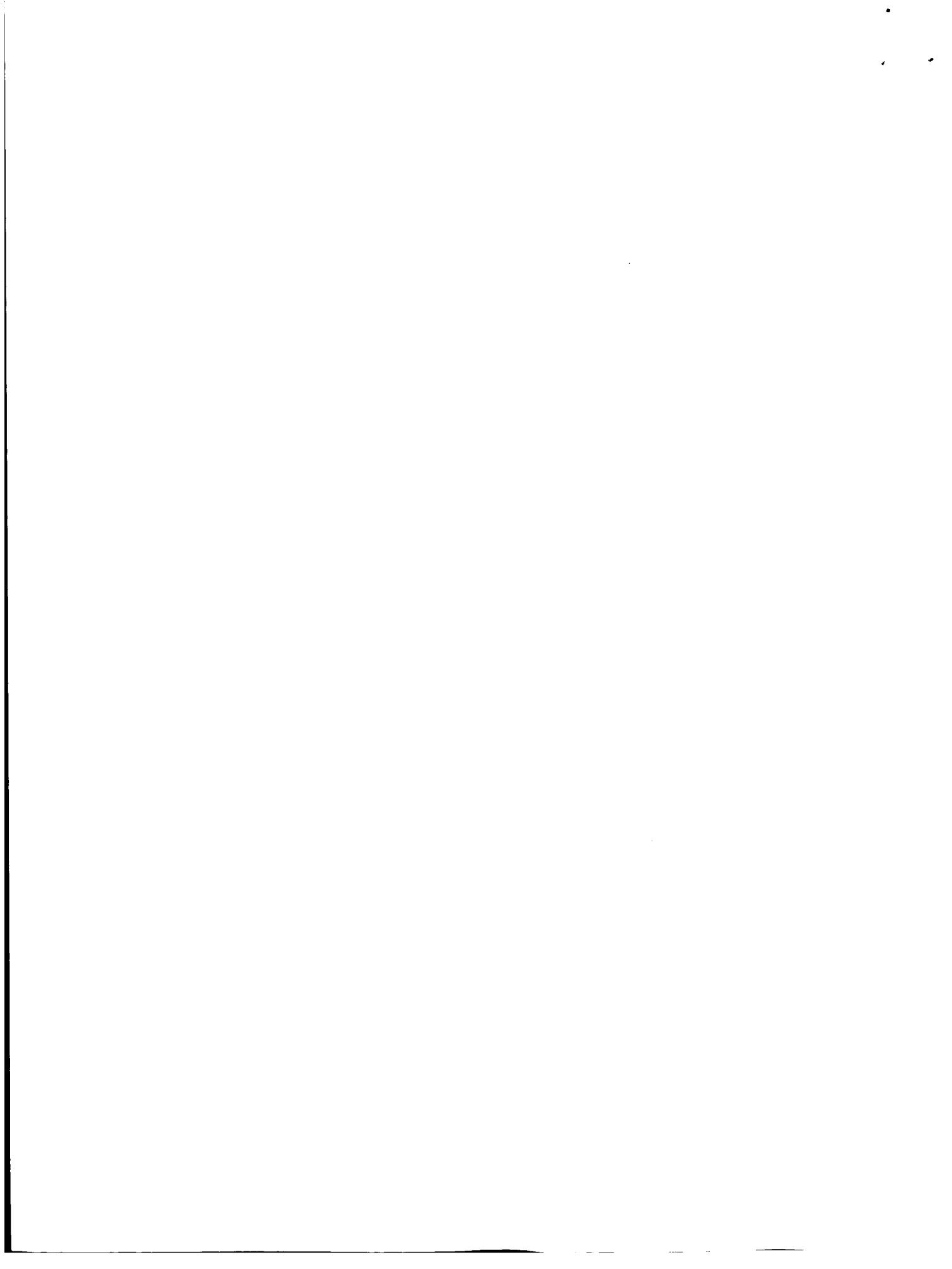
Appendix B. PERIODICALS

1. ANNUARIO (ANNUAL). Astrophysical Observatory, University of
     Florence, Italy.
     Observational data in graphic form. Heights of the chromosphere at
     different points of the limb.

2. L'ASTRONOMIE. Société Astronomique de France. Paris.
     Planispheric maps of the chromosphere; sunspot details, plages,
     faculae,
     Noteworthy protuberances for each rotation of the Sun. Waldmeier's
     monthly and annual tables of relative Wolf numbers.

3. BOLETIN ASTRONOMICO. Observatorio de Madrid
     Observation data, number of groups, Wolf numbers per quadrant and per
     hemisphere. Corrected Wolf numbers. Mean monthly numbers
     of groups
     Areas of sunspots. Areas of sunspots per hemisphere.

4. BOLLETINO DI GEODESIA E SCIENZE AFFINI. Istituto Geografico
     Militare.
     Florence, Italy.
     Observations made at Arcetri. The results are given in graphic form
     for Wolf numbers, areas of protuberances, and height of the
     chromosphere.

5. BULLETIN OF SOLAR PHENOMENA. Observatory of Tokyo
     Observations of sunspots, calcium plages, protuberances; intensity of the
     coronal line 5303 A; solar radio emission of 9600, 3000, 200, 100,
     and 67 Mc/s.

6. CIEL ET TERRE. Société Belge d'Astronomie. Brussels.

7. COELUM. Periodical for the Popularization of Astronomy. University of
     Bologna, Astronomical Observatory. Italy.

8. CONTRIBUTI SCIENTIFICI. Circolare, Osservatorio Astronomico
     di Roma.
     Heliographic position, classification, and areas of observed sunspot
     groups, daily total sunspot areas.

9. FEN FAKÜLTESI MECMUASI, SERI C (FACULTY OF SCIENCE REVIEW, SERIES C),
   Istanbul University
   Position and variation of groups of sunspots. Daily numbers of the sunspots and of the sunspot groups.

10. JOURNAL OF THE BRITISH ASTRONOMICAL ASSOCIATION.
    Hounslow West, Middlesex, England.
    Sunspot counts and mean daily frequencies established by members of the Solar Section, and Annual Report on Solar Acitivity.

11. MITTEILUNGEN. Astrophysikalisches Observatorium, Potsdam, Germany.
    Polarity and maximum intensity of the magnetic field.

12. MITTEILUNGEN. Fraunhofer Institut, Freiburg i. Br., Germany.
    Observations made at Freiburg and Anacapri.
    Regularly published also in Z. Astrophysik.

13. QUARTERLY BULLETIN OF SOLAR ACTIVITY. Zürich.
    See: VIERTELJAHRSSCHRIFT.

14. SOLAR BULLETIN. American Association of Variable Star Observers.
    Flushing, New York.

15. SOLNECHNYE DANNYE (SOLAR DATA), Byulleten', Akademiya Nauk, S.S.S.R.

16. TSIRKUL'YAR. Tashkent Astronomical Observatory, USSR.
    Results of observations. Lists of sunspot groups, protuberances; distribution at five-degree intervals in the two hemispheres.

17. VIERTELJAHRSSCHRIFT DER NATURFORSCHENDEN GESELLSCHAFT. Zürich
    Number of days of observation at public and some private observatories. Daily relative numbers of sunspots. Daily number of sunspot groups, their distribution. Faculae, protuberances. Intensity of coronal radiation. Solar radio emission at 10.7-cm wavelength.

18. ZEITSCHRIFT FUER METEOROLOGIE. Akademie Verlag. Berlin.
    Solar activity values determined at the observatories of Zürich, Locarno, and Arosa. Provisional relative numbers of sunspots, determined at the Zürich Observatory.

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13. ABSTRACT

This bibliography contains 512 citations to articles on solar activity as evidenced by sunspots, flares, and cosmic and terrestrial effects. In addition, there are listed books dealing with solar activity, and observatory publications and other periodicals reporting routinely observational data and forecasts of periodic events.

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